Punyashlok Ahilyadevi Holkar Solapur University

Criterion III – Research, Innovations and Extension

Key Indicators - 3.4 Research Publications and Awards

Metric No.	
3.4.5	*Number of research papers in the Journals notified on UGC website during the year*

Sensors & Actuators: B. Chemical 371 (2022) 132584

Contents lists available at ScienceDirect

Sensors and Actuators: B. Chemical

journal homepage: www.elsevier.com/locate/snb

Hydrothermally engineered WO_3 nanoflowers: A selective detection towards toxic NO_2 gas

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ARTICLE INFO

Keywords:
WO_3 NFs
Hydrothermal
FESEM
XPS
NO_2 sensor

ABSTRACT

Nanoflowers (NFs) of WO_3 is decorated on glass substrate by inexpensive hydrothermal method at very low temperatures (80 and 100 °C). The structural investigations are studied through X- ray diffraction and surface morphological study of WO_3 NFs were examined using transmission electron microscopy, field emission scanning electron microscopy, Brunauer- Emmett- Teller, and X- ray photoelectron spectroscopy technique. WO_3 NFs exhibited hexagonal crystal structure. The porous structure of WO_3 NFs possessing a specific surface area of 38.13 m^2/g. WO_3 NFs (W_6 sample) shows remarkable gas sensing towards toxic NO_2 gas (225% response for 100 ppm at operating temperature 200 °C). WO_3 NFs exhibits excellent reproducibility and stability (80%). An interaction mechanism of gas and WO_3 NFs studied using an impedance spectroscopy.

1. Introduction

WO_3 is a highly versatile n-type transition metal oxide semiconductor. Noteworthy physico-chemical properties as the advantages related with the field emission, high sensitivity towards gas sensor, or negative values of capacitance in the advancement of novel signal amplifying devices and complex phases (hexagonal and monoclinic) greatly attracted researchers. The WO_3 can be nanostructured into variety of arrangements as one dimensional (1D), two dimensional (2D) and three dimensional (3D) [1–5].

The 3D hierarchical architectures can also be derived from nanostructures, which are built with small-scale nano-blocks, plates, rods or cubes. Due to large specific surface area of 3D hierarchical architecture provides plentiful active sites for the gas sensing. Therefore, 3D hierarchical architecture improves gas sensing, compared to other structures, the example of 3D architecture is nano flowers [2,6–9].

The present work was aimed to prepare WO_3 NFs by inexpensive and one step hydrothermal method without any surfactants, catalysts and reducing agents at temperature 80 and 100 °C. The WO_3 NFs were analyzed by physico-chemical methods. The gas sensing performance of WO_3 NFs were tested from 50 to 300 °C for NO_2, CO, H_2S, SO_2 and NH_3 gas. The results showed excellent sensing performance to NO_2 gas (225%). interaction mechanism of gas and WO_3 NFs was elucidated using an impedance spectroscopy.

2. Experimental details

2.1. Synthesis of WO_3 NFs

Analytical reagents were used in our experiment are with 99.9% purity and used as received. WO_3 NFs has been synthesized by a simple, economical hydrothermal method. 2.31 g of Na_2WO_4 was dissolved in distilled water (DW) and magnetically stirred for 30 min, to get the transparent solution. 3 M HCl was added dropwise in the prepared solution, to adjust pH −1. Subsequently, with the addition of 3 M HCl, the solution turns in to transparent yellow. The resultant solution was moderately stirred for half hour. Simultaneously, the glass substrates of dimensions $3cm \times 1cm$ were cleaned by standard procedure and was placed inclined in hydrothermal teflon reactor. The resultant solution was transferred to hydrothermal teflon reactor of volume 100 ml, which contained the glass substrates and was sealed in autoclave. The autoclave was heated for 2 h at 80 °C, say the sample W_1. The hydrothermal reactions parameters are given in Table 1.

Subsequently, at the reaction completion, the autoclave cooled to ambient temperature. White films formed on glass substrates. The films were rinsed in DW and dried for 1 h at 100 °C. The synthesized films

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https://doi.org/10.1016/j.snb.2022.132584
Received 27 May 2022; Received in revised form 11 August 2022; Accepted 26 August 2022
Available online 29 August 2022

Spray Synthesized Mn-doped CuO Electrodes for High Performance Supercapacitor

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A pristine copper oxide and manganese-doped copper oxide nanostructured films were prepared by simple spray pyrolysis technique. A study of the effects of Mn doping with three different concentrations as 2, 4, and 6 wt% were studied in the view of enhancement of supercapacitive performance of copper oxide electrode. The 6 wt% manganese-doped copper oxide thin film changed their surface morphology considerably favorable to the exchange of ions in the Na_2SO_4 electrolyte. The electrochemical properties of the pristine copper oxide and manganese-doped copper oxide were investigated in 1 M Na_2SO_4 electrolyte within the potential window of −1.0 to 0.4 V. A maximum specific capacitance of 801.61 F/g was obtained for the manganese-doped copper oxide thin film electrode.

Introduction

Supercapacitors (SCs), also known as electrochemical capacitors, are one of the most promising candidates. It exhibits attractive characteristics such as high power density, permanent charge-discharge cycle, low series resistance, longer life cycle, and wide range of operating temperature, easily maintenance, and environmental friendliness than secondary batteries.[1–4] The charges are stored in supercapacitors via two principles: diffusion controlled kinetics (pseudocapacitors) and surface-controlled kinetics (electrical double-layer supercapacitor).[5,6] Currently transition metal oxides electrodes have a great choice as sophisticated supercapacitor due to transition metal oxides abundant availability, environmentally friendly, large surface area as well as high theoretical specific capacitance.[7,8] Although, transition metal oxides/ hydroxides for example, RuO_2, V_2O_5, NiO, $Ni(OH)_2$, Co_3O_5, $Co(OH)_2$, MnO_2 were used to achieve excellent supercapacitive performance.[8,9] However RuO_2 is restricted for its commercial use due to expensive, toxic, and less abundant.[8] Among aforesaid, it is possible for transition metal oxides to have a variety of oxidation states which can enhance redox charge transfer, resulting in much higher specific capacitances.[10] A promising electrode material, manganese oxide has a high specific capacitance, an ideal charge-discharge curve, is readily available, and is stable. CuO is an attractive choice for energy storage since it is low cost, low toxicity, abundant, environmentally friendly, and has a large surface area and high conductivity.[10] Manganese oxides have been found as one of the most promising candidate for supercapacitor applications due to their natural abundance, low cost.[1] Based on above considerations, we designed a pristine and Mn-doped CuO electrodes by spray pyrolysis technique. Pang et al. synthesized MnO_2 and reported maximum specific capacitance of 689 F/g at a current density of 10 mA/cm² in 6 M KOH electrolyte.[11] More et al. deposited Mn_3O_4 and found maximum specific capacitance of 527 F/g at a scan rate of 5 mV/s in 1 M Na_2SO_4 electrolyte.[1] Xia et al. synthesized MnO_2 and reported maximum specific capacitance of 364 F/g at 10 mV/s in 1 M Na_2SO_4 electrolyte.[12] In the research community, researchers have focused on a synthesis of mixed metal oxides than single metal oxide to achieve the desired performance of supercapacitor. In addition to that following unique features of metal oxides can breakthroughs for supercapacitors such as i. co-existence of two different metal oxides in a single crystal structure could improve the electrical conductivity than single one, ii. nanoporous metal oxides can provide a higher surface area.[7] Durai et al. synthesized a pristine and Mn-doped CuO electrodes by a reactive radio frequency magnetron sputtering technique and reported maximum specific capacitance of 10 and 81.80 mF/cm² at a scan rate of 10 mV/s in 3 M KOH electrolyte, respectively.[2] Racik et al. prepared CuO and MnO_2–CuO nanocomposite electrodes and showed maximum specific capacitance of 191.06 and 279.12 F/g, respectively.[10] Suresh et al. synthesized CuO and 5 wt% Mn-doped CuO and reported maximum specific capacitance of 375 and 625 F/g in 2 M KOH electrolyte at 2 mV/s, respectively.[13] Shinde et al. deposited $CuO/Cu(OH)_2$ and Mn: $CuO/Cu(OH)_2$ hybrid electrodes at various Mn concentrations. As a result $CuO/Cu(OH)_2$ and 3%

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Supporting information for this article is available on the WWW under https://doi.org/10.1002/slct.202202504

Journal of Electronic Materials
https://doi.org/10.1007/s11664-022-10019-9

ORIGINAL RESEARCH ARTICLE

Mn-Incorporated α-Fe_2O_3 Nanostructured Thin Films: Facile Synthesis and Application as a High-Performance Supercapacitor

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Received: 9 June 2022 / Accepted: 3 October 2022

Abstract

Among all the transition metal oxides, iron oxide-based materials are excellent for supercapacitor performance. Here, Mn-incorporated α-Fe_2O_3 (Mn:α-Fe_2O_3) nanostructured thin films (with 3%, 5%, and 7% Mn) are prepared via spray pyrolysis. All the synthesized nanostructured thin films are characterized by x-ray diffraction (XRD), optical study, Fourier transform infrared spectroscopy (FTIR), field emission scanning electron microscopy (FESEM), transmission electron microscopy (TEM), and contact angle for the structural, optical, morphological and wettability analysis, respectively. The band gap of Mn:α-Fe_2O_3 nanostructured thin films is tuned by changing Mn concentration. The increasing Mn concentration shifts the valance band edge towards the conduction band edge, reducing the band gap. The linear band gap decrease of 0.44 eV with the addition of Mn concentration, along with the band gap reduction, affects supercapacitive performance. The prepared 7% Mn:α-Fe_2O_3 nanostructured electrode exhibits excellent specific capacitance of 688.6 F g^{-1} at a scan rate of 5 mV s^{-1} in 1 M Na_2SO_4 electrolyte, energy density (6 Wh kg^{-1}), and power density (12 kW kg^{-1}) at a current density of 5 mA g^{-1}.

Keywords Spray pyrolysis technique · Mn:α-Fe_2O_3 nanostructure · contact angle · electrochemical analysis · supercapacitor

Introduction

In recent years, a multiplicity of energy storage devices, viz. capacitors, supercapacitors, and batteries, are accessible in daily life. However, the consequences of such energy storage devices primarily depends not only on the effectiveness but also on the stability of the electrode resources.[1] In pursuit of more advanced storage devices, highly requested research efforts are being made in modern society for effecting large-scale employability in the area of durable energy storage devices. The currently available supercapacitors are the best devices since they act as a bridge between the traditional capacitor and secondary batteries. The supercapacitors are characterized by a high energy density, a long life cycle, excellent rate capabilities, a wide operating temperature range, enhanced safety, efficiency, and good endurance.[2,3] The charge storage mechanisms in supercapacitors are based on two principles: one is the pseudeocapacitor mechanism which relies on reversible redox reaction. The other is the electrostatic adsorption ions at the electrode/electrolyte interface and it possesses low energy density.[1–4] A supercapacitor stores charge at the electrodes; it can be charged and discharged at a higher rate and can undergo longer cycles than a battery.[5] Supercapacitors have the potential to be used in portable electronic devices and power hybrid cars.

A transition metal oxide-based supercapacitor electrode exhibits a specific capacitance that is 10–100 times higher than carbon-based materials.[6] Electrode materials with a large surface area have a high specific capacitance, while nanoscale materials tend to have higher surface area which increases electrode–electrolyte contact and enhances charge transfer reactions. A metal oxide such as iron oxide has been widely used in pigments, catalysts, sensors, environmental pollutant agents, biomedical materials and electrode

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Published online: 27 October 2022

J Mater Sci: Mater Electron (2023) 34:781

Highly sensitive and selective PAni-CeO_2 nanohybrid for detection of NH_3 biomarker at room temperature

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Received: 21 November 2022
Accepted: 26 February 2023

ABSTRACT

An impressive room temperature (25 °C) NH_3 biomarker sensor has been developed using polyaniline (PAni)-CeO_2 nanohybrid by facile oxidative polymerization process on glass substrates. The structural properties of PAni-CeO_2 nanohybrids were disclosed using X-ray diffractometry, and the surface morphology was studied using field emission scanning electron microscopy, transmission electron microscopy and X-ray photoelectron spectroscopy techniques. The PAni-CeO_2 nanohybrids shows cubic crystal structure with strongly interconnected nanofiber surface morphology. The chemiresistive gas sensing performance of the PAni-CeO_2 nanohybrid sensor reveals that the CeO_2 nanoparticles (NPs) have a significant impact on the hybrid sensor. The CeO_2 NPs in the PAni-CeO_2 nanohybrid might block the charge carriers or reduce the delocalization length and hence increase the resistance of the nanohybrid when exposed to NH_3 gas. PAni-CeO_2 (50 wt%) nanohybrid sensor exhibits (80%) response toward 100 ppm NH_3 which is about four-fold higher than pristine PAni (26.70%), showing excellent stability (78.75%), admirable reproducibility with least response time (9.31 s), and such an excellent performance could be imputed to a high explicit surface area of CeO_2 for significant chemical interaction and the formation of interfacial heterojunction bond with CeO_2, exploring PAni-CeO_2 (50 wt%) nanohybrid as a potential candidate for biomarker NH_3 detection. An impedance spectroscopy was used to investigate the interaction mechanism between the NH_3 gas and the PAni-CeO_2 nanohybrid sensor.

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https://doi.org/10.1007/s10854-023-10181-8
Published online: 20 March 2023

Electrospun Fabric Tin Oxide 1-D Nanofibers: Approach Towards Flexible Electrode for Supercapacitor Application

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Herein, the facile electrospinning route is demonstrated to fabricate nanofibrous based tin oxide flexible electrode processed at different annealing temperatures and further envisaged in high-performance energy storage application. Tin oxide (SnO_2) processed at 400 °C of annealing temperature showcased excellent specific capacitance (844 F/g) along with interfacial capacitance (0.1434 F/cm²) at 1 mV/s of scan rate which was tested in 1 M NaOH aqueous electrolyte and exhibited remarkable stability even after 2000 cycles. Nanofibers with beads-formation type morphology of the electrodes were confirmed through scanning electron microscopy. Hydrophilic nature of the electrode surface was confirmed by water contact angle measurements. The structural study was done with the help of X-ray diffraction (XRD), Raman spectroscopy, Energy dispersive X-ray analysis (EDAX) and X- ray photoelectron spectroscopy (XPS). In addition, the flexible symmetric supercapacitor device is believed to have an excellent flexibility and electrochemical stability during mechanical bending up to 180°, suggesting SnO_2 as promising electrode material for applications in future flexible and wearable electronics devices.

Introduction

The crisis of traditional fuel depletion and environmental issues appeal for not only booming development of long-term sustainable clean alternative energy resources and management systems, but also more advanced flexible devices due to growing trend towards lightweight, thin and portable electronics multimedia in modernization of society. Supercapacitors (SCs) have gained enormous attention as an electrochemical storage device with wide range of potential applications in portable electronic systems for their distinct characteristics of lower maintenance cost, rapid charge-discharge rate and longer cycle life.[1–4] The promising properties as delivering higher power and storing greater energy within a short time, SCs are complementary to those traditional capacitors and batteries. To date, several strategies have been demonstrated for flexible supercapacitors, such as carbon-based smart textiles.[5] Cellulose nanofibers-graphene based supercapacitor,[6] electroactive conducting polymers' composites and fiber-shaped supercapacitor.[7,8] Consequently, great efforts have been dedicated to enhance supercapacitive performance of materials based on superficial non-Faradic reaction in electrochemical double-layer capacitors (EDLCs), i.e. Carbon-supported materials regarded promising candidates as flexible free-standing electrodes due to superior cyclic stability, mechanical strength, and flexibility. However, it suffers from limited ionic conductivity, poor electrolyte accessibility, which could hinder their inherent capacitive behavior.[9,10] Meanwhile, the pseudocapacitors consisting of redox active materials viz. transition metal oxides and conducting polymers rely on reversible faradic reaction associated at electrode/electrolyte surface, which is expected to provide higher electrochemical performance than EDLCs.[11,12] As a result of poor stability and relatively lower capacitance of conducting polymer materials,[13] most researchers have been extensively investigating the variety of oxide-based nanomaterials like RuO_2, NiO_2, Co_3O_4, and MnO_2[14–17] in many emerging applications owing to engrossing chemical and electrical properties, especially for energy storage devices. Ruthenium oxide, demonstrated as an earlier material to exhibit excellent electrochemical performance. However, due to high making cost, toxicity and rarity in the earth's crust, ruthenium is less attractive in commercial applications.[14,18] Also Microsupercapacitors (MCSs) have grabbed great interest due to their planar structure, small size and excellent flexibility.To realize such MCSs, various techniques like Inkjet printing, screen printing, laser ascribing, plasma etching and so on are used for fabrication of flexible electrode. Various metal oxide and fabric based materials like poly(3,4-ethylenedioxythiophene) poly(styrenesulfonate)@MnO_2 electrodes can be used for microsupercapacitors.[19–21] Nowadays, new class of soft fuctional materials consisting of conducting hydrogel based electrode and electrolytes which can be utilised for stretchable and self-repair supercapacitors after damage. Polyaniline based hydrogel electrode, Polypyrrole based hydrogel electrode and Polythiophene based electrode are chosen as electrode material for self-repair supercapacitors. Polyethylene oxide(PEO) based hydrogel electrolyte and Polyvinyl alcohol(PVA) based hydrogel electrolyte are preferred as electrolyte in the wearable electronics.[22]

Various approaches have been implemented to fabricate the flexible electrodes for flexible supercapacitor devices that includes fabrication of flexible free-standing films of active

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ChemistrySelect

Research Article
doi.org/10.1002/slct.202204750

Chemistry Europe
European Chemical Societies Publishing

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Influence of the Camphor Sulphonic Acid (CSA) Intercalation on the Micro-structural and Gas Sensing Properties of Polyaniline-CeO_2 Nanohybrid for NH_3 Gas Detection

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Developing a high performance sensing materials operating at room temperature (30 °C) is eminently a challenging task. The facile chemical oxidative polymerization route was employed for the synthesis of PAni-CeO_2 nanohybrids with CSA intercalation (10–50 wt%) on the chains of protonated PAni. The cubic crystal structure of PAni-CeO_2-CSA nanohybrids were revealed by X-ray diffractometry (XRD). Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) were employed for the structural and morphological investigations. X-ray Photoelectron Spectroscopy (XPS) and Raman spectroscopy confirmed the formation of PAni-CeO_2-CSA nanohybrid. The consequences of CSA intercalation on the gas sensing performance of PAni-CeO_2 nanohybrids are explored through custom designed sensing system. The gas sensing investigations revealed that PAni-CeO_2-CSA (50 wt%) nanohybrid exhibited highest response (93%) towards 100 ppm NH_3 at 30 °C. Advantageously, CSA intercalated PAni-CeO_2 nanohybrid gas sensor delivered fast response and quick recovery (8 sec and 482 sec) with admirable stability (84.09%) towards NH_3 at 30 °C.

Introduction

Reproducible, inexpensive and highly active gas sensors are considered significant for versatile applications such as manufacturing, environmental, health and military operations to avoid impending hazards for human being and environment.[1–3] Ammonia (NH_3) is a toxic and combustible contaminant, posturing continuous risks to human health and ecology if it reaches to 25 ppm in 8 hrs.[4] NH_3 spoils the ecosystem because of natural and artificial sources like industrialization,[5] automobile exhaustion[6] and household activities. Therefore, an excessive efforts have been carried out for developing NH_3 gas sensor that is miniaturized, convenient and highly sensitive towards harmful NH_3 gas at room temperature for human being and environmental protection. Many gas sensing materials are available, such as conducting polymers,[7,8] semiconducting metal oxides (SMO)[9,10] and carbon-based materials,[11,12] differ in their behaviors and gas sensing performances. Nowadays, semiconducting metal oxides such as cerium oxide (CeO_2), tungsten oxide (WO_3), iron oxide (Fe_2O_3) and tin oxide (SnO_2) are used in gas sensors because of excellent stability and improved gas sensing properties. Cerium oxide (CeO_2) is n-type semiconductor metal oxide with outstanding electrical conductivity and excellent redox reactions that improve gas sensing characteristics.[13,14] On the other hand, cerium oxide (CeO_2) comprising high operating temperature with heat that induced crystal growth and hazard of explosion, it restricts the practical applications.[15] Conducting polymers are more reliable candidates due to their low price, most significant selectivity, fast response and recovery time at room temperature as compared with metal oxides.[16] Amongst the conducting polymers, PAni is more efficient for revelation of toxic NH_3 gas at 30 °C.[17,18] Moreover, pristine PAni is simple to synthesize and it comprises with distinct molecular structure and excellent stability. But, it has some drawbacks, including low selectivity, long-term stability and extended response and recovery time.[19] The gas sensing performances of cerium oxide and pristine PAni are inconvenient and they constrained by a number of factors. Therefore, for the achievement of excellent gas sensing performance, the composite material comprising with organic and inorganic material properties such as PAni-CeO_2 nanohybrid was synthesized.

In the present research work, CSA intercalated PAni-CeO_2 nanohybrid was synthesized utilizing a facile polymerization process to improve the gas sensitivity, selectivity, stability and response-recovery time.[20,21] The role of CSA is a potential dopant, which increases the conductivity as well as stability of PAni-CeO_2 nanohybrids.[22,23] Therefore, CSA intercalated PAni-CeO_2 nanohybrids delivers excellent gas response towards NH_3 at 30 °C. The related investigations for gas sensors were studied. Navale et.al[22] described the fabrication of CSA (10–50 wt%) intercalated PPy-Fe_2O_3 hybrid nanocomposites for

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Nano-Structures & Nano-Objects 34 (2023) 100964

Contents lists available at ScienceDirect

Nano-Structures & Nano-Objects

journal homepage: www.elsevier.com/locate/nanoso

Intercalation of two-dimensional graphene oxide in WO_3 nanoflowers for NO_2 sensing

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ARTICLE INFO

Article history:
Received 14 November 2022
Received in revised form 20 January 2023
Accepted 1 March 2023

Keywords:
WO_3-GO nanohybrid
Hydrothermal
XPS
BET
NO_2 sensor

ABSTRACT

Chemiresistive WO_3-GO (WG) nanohybrid sensors were designed by a cost-effective hydrothermal process. The structure, morphology, composition and surface features of the prepared WG nanohybrids were explored by an array of analytical techniques, such as X-ray diffractometry (XRD), Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), field emission scanning electron microscopy (FESEM), energy dispersive X-ray analysis (EDAX), high-resolution transmission electron microscopy (HRTEM) and Brunauer–Emmett–Teller (BET) surface profiling. The gas sensing performance of the WG nanohybrids reveals that the small amount of GO significantly impacts the sensor performance. The enhanced gas sensing performance of the WG nanohybrid sensor with a GO content of 3 weight% exhibits an excellent response to 100 ppm of NO_2, attaining 239%, which is nearly fourfold higher than that of pristine WO_3 (61%) at 150 °C, and shows outstanding selectivity, reproducibility and stability (84.5%). Impedance spectroscopy was employed to understand the interaction between the NO_2 gas molecules and the WG nanohybrid.

1. Introduction

A rapid economic boom throughout the early decades fueled the speedy increase in global energy consumption. Energy is mainly obtained from the burning of fossil fuels. As a result, the environment gets contaminated with poisonous gases released from burning fossil fuels. Pollutant gases emitted by the combustion of fuels, such as nitrogen dioxide (NO_2), carbon monoxide (CO), hydrogen disulfide (H_2S) and others, pollute the atmosphere. These are harmful to both living organisms and humans. In a short period, exposure to NO_2 ($\geq$ 10 ppm) may lead to fast nasal and throat irritation, as well as edema and distress. NO_2 concentrations exceeding 100 ppm cause death by suffocation when inhaled within a short time frame. Additionally, NO_2 causes photochemical smog, acid rain and accelerates microscopic particle formation. Thus, for environmental and health monitoring, cost-effective and simple chemiresistive sensors with outstanding NO_2 sensing capability are of the utmost importance [1–4].

Transition metal oxides, such as WO_3, TiO_2, SnO_2, ZnO, and Fe_2O_3 [5,6], have been extensively studied in the last few decades for NO_2 detection because of their semiconducting nature. Y.H. Navale et al. have reported a CuO nanocube sensor for NO_2 detection using the thermal evaporation technique [2]. Lizhai Zhang et al. have worked on a CeO_2/Graphene heterostructure for NO_2 sensing using a hydrothermal approach [1]. Hongwen Zhang et al. have explored WO_3 decorated using Au nanoparticles for the selective detection of NO_2 gas [4]. Shibin Sun et al. have synthesized nanocomposites of graphene nanoplatelets and $WO_3 \cdot H_2O$ using a simple precipitation method [7]. WO_3 nanoflowers (NFs) are 3D nanostructures [8–17] with an ability to detect NO_2 gas that have been extensively investigated over a few decades, attributable to their low cost, excellent chemical stability, crystal structures and superior sensitivity. It is recognized that the effect of gas-sensing of WO_3 NFs is initiated after the interaction among oxygen ionic species (O^{2-}, O_2^- and O^-) adsorbed on the nanostructured surfaces and the gas molecules [7,18].

The inherent properties of WO_3 NFs, such as absorption of low visible light and fast recombination of carriers, reduce its utility in some applications, such as photocatalysis and gas sensing. We can straightforwardly overcome the shortcomings of pristine WO_3 NFs by hybridization with nanomaterials of the carbon family (carbon nanotubes and graphene) to improve their performance [19,20]. Graphene oxide (GO) is the most impressive graphene-based structure, because of its exclusive surface

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https://doi.org/10.1016/j.nanoso.2023.100964
2352-507X/

ES Energy & Environment

DOI: https://dx.doi.org/10.30919/esee8c742

Effect of Temperature on Structural, Morphological and Electrochemical Properties of the Spray Pyrolysed CuO@Stainless-steel Electrodes Via Non-aqueous Route: Supercapacitive Approach

Sandesh V. Kambale and B. J. Lokhande*

Abstract

In this work, highly pure nano-structured thin films of cupric oxide (CuO) were synthesized at various deposition temperatures from 250 to 400 °C on stainless steel substrate by spray pyrolysis. Different analytical techniques and electrochemical measurements were used to study the effect of deposition temperature on the physical and electrochemical properties of the prepared CuO material. The results showed that, along with morphological modifications, the wettability, and crystallinity of prepared polycrystalline CuO material increase with the increase in deposition temperature. Further, the enhanced specific capacitance (SC) with an increase in deposition temperature confirmed that deposition temperature affects the supercapacitive properties of the nano-structured CuO material. High specific capacitance and low internal resistance of the trapezium shape nano grain-like CuO material revealed its suitability as an impressive candidate in supercapacitor applications. The highest assessed value of SC was 3285.7 Fg^{-1} at 2 mVs^{-1} scan rate in 1 M aqueous KOH electrolyte. The galvanostatic charge-discharge study reveals the pseudocapacitive behavior of the deposited CuO material.

Keywords: Supercapacitor; Spray Pyrolysis; Copper oxide; Substrate temperature; Metal oxides.
Received: 25 April 2022; Revised: 15 June 2022; Accepted: 24 June 2022.
Article type: Research article.

1. Introduction

The high performing electrical energy storage devices are required for portable electronic devices and electric vehicles. Due to their low cost, high SC, high specific power (SP), and long cycling stability, supercapacitors are suitable for portable electronic devices. In a supercapacitor, the charges are stored electrostatically (known as electrical double layer EDLC) as well as faradaically (known as pseudocapacitor).[1] EDLC electrodes are prepared using carbon-based materials like reduced graphene oxide, carbon nanotubes, etc. whereas, pseudocapacitor material involves conductive polymers like polypyrrole, polythiophene, polyaniline, derivatives of polythiophene, etc. and/or metal oxides. As in pseudocapacitors, the charge storage occurs through the oxidation-reduction reactions, elements with multiple oxidation states are suitable for the preparation of pseudocapacitive electrodes.[1-4] Pseudocapacitors are mainly composed of metal oxides like NiO, CuO, RuO_2, TiO_2, SnO_2, Fe_3O_4, Fe_2O_3, V_2O_5, Co_3O_4, MoO_3, etc.[1-10] CuO has high theoretical specific capacitance, a variety of surface morphologies, an abundance of precursors, and non-toxic nature.[11-13] The thin films of CuO were prepared by using many techniques such as electro-deposition,[11] chemical vapour deposition,[12] successive ionic layer adsorptions and reaction,[13] spin coating,[14] plasma evaporation,[15] automatic spray pyrolysis,[16] sol-gel synthesis,[17] solid-state reaction[18] etc. Among these, the spray pyrolysis technique is easy in controlling various deposition parameters, simple to operate, and cost-effective. It works in an open atmosphere and is suitable for the mass production of homogenous and uniform nanostructured thin film electrodes of metal oxide on conducting stainless steel substrate for supercapacitor applications.

Many researchers showed that the variation in the deposition temperature affects the rate of reaction and hence the structure and the surface morphology[11-18] which definitely alters the supercapacitive properties of the nano-structured thin film materials. Hence, the object of this work is to study

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Materials Letters

Volume 351, 15 November 2023, 134999

Symmetric supercapacitor comprising Ni_2O_3: $Fe_{1.7}Ni_{1.43}O_4$ electrodes prepared by ultrasound chemical bath deposition route

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https://doi.org/10.1016/j.matlet.2023.134999

Abstract

Application of ultrasonic frequencies for synthesis of electrode materials is beneficial for the proper nucleation and growth of electrode material on substrates. Ni_2O_3:$Fe_{1.7}Ni_{1.43}O_4$ electrodes (N100) were prepared by novel ultrasonic chemical bath deposition (UCBD). The formation of material was confirmed by XRD and further corroborated by EDX analysis. Hydrophilic nature was affirmed by contact angle of 15°. FESEM exhibits formation of interconnected nanograins of various sizes. Average grain size and average surface roughness were was 90nm and 100nm confirms the formation of a monolithic layer. The prepared symmetric supercapacitor shows maximum specific capacitance of 202.00 Fg^{-1} with almost 83% retention even after 2000 cycles.

Graphical abstract

ScienceDirect

Inorganic Chemistry Communications

Volume 154, August 2023, 110998

Short Communication

Nanoarchitectonics of Bi_2CuO_4 electrodes for asymmetric Bi_2CuO_4//AC solid-state device in supercapacitor application

R.G. Bobade [a], U.T. Nakate [b], P. Raosaih [c], M. Ouladsmane [d], B.J. Lokhande [e], R.C. Ambare [e]

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https://doi.org/10.1016/j.inoche.2023.110998

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Abstract

The fashionable investigates the bismuth oxide nano-materials were synthesized using bismuth nitrate as an ingredient. The samples were deposited using the electrodeposition technique via an aqueous route with varying deposition time variations. Prepared samples were annealed at 573 K in a muffle furnace. All deposited thin film electrodes were physical and electrochemical characterized via X-ray diffraction (XRD), Field emission scanning electron microscopy (FE-SEM), Elemental mapping, Energy dispersive X-ray spectroscopy (EDX), Contact Angle, X-ray photoelectron spectroscopy (XPS) and supercapacitive measurements. XRD of all deposited samples reveals polycrystalline nature with a tetragonal crystal structure. FE-SEM shows revolutionary morphological images of spruce leaf-like architecture. EDX analysis shows the elemental mapping of the deposited materials. TEM revels the formation of nano granules structures indicating the formation of the crystalline bismuth oxide. XPS confirms the formation of Bi_2CuO_4. All samples show the hydrophilic nature of deposited materials from contact angle. Cyclic voltammetry (CV), Galvanostatic charge–discharge (GCD), and impedance measurements are used to examine the supercapacitive characteristics in an aqueous 1 M KOH electrolyte. All CV curves show mixed capacitive nature. The results of the investigations are highest specific capacitance (SC) of 706.47 F/g at a scan rate of 2 mV/s was calculated. The specific energy (SE) of 49.89 Wh/kg, and specific power (SP) of 17.51 kW/kg were calculated at 40 mA/cm^2 current density. The capacitive nature and internal resistance were observed using the Nyquist plot for the optimized electrode which is about 2.11 Ohm. CV, GCD, and impedance measurements are used to characterize the electrochemical parameters of the asymmetric supercapa

ES Energy & Environment

DOI: https://dx.doi.org/10.30919/esee909

Structural, Morphological, and Electrochemical Analysis of Electrodeposited Iron Oxide Electrodes

P. B. Dahivade, S. N. Pawar and B. J. Lokhande*

Abstract

The present work depicts the preparation and electrochemical study of hematite (Fe_2O_3) electrodes by cathodic electrodeposition. The synthesis has been carried out at deposition potential 2.3 V using the potentiodynamic cathodic electrodeposition for 30 min on stainless-steel (SS) strips. 20 ml of 0.1 M aqueous solution of $FeSO_4$ has been taken as source material. XRD patterns of the prepared flexible electrodes (FE) approve the formation of hematite. Further, the value of contact angle 10.5° indicates the greater hydrophilic nature of the material, which is appropriate to the aqueous electrolyte. The interconnected nanoflakes provide a high surface area which is essential for high-charge storage. The cyclic voltammetric (CV) analysis shows a quasi-irreversible performance of the electrodes. Galvanostatic charge-discharge (GCD) analysis was carried out using chronopotentiometry (CP). The detected supreme specific capacitance (SC) was 2085.20 Fg^{-1}.

Keywords: Hematite, Pseudo capacitors, Contact angle, Cyclic Voltammetry, Supercapacitor.
Received: 01 June 2023; Revised: 07 June 2023; Accepted: 16 June 2023.
Article type: Research article.

1. Introduction

Energy-storing gadgets are undertaking a strong systematic and scientific evolution in instruction to familiarize with a novel maintainable energy model that will essential to promote renewable power and self-directed electric automobiles. Mutually batteries and supercapacitors are helping from strong efforts to overcome their main disadvantages, that is sluggish rates and little power for batteries, and comparatively small energy density in the situation of supercapacitors.[1] But in totaling to progress the inherent performance of electrode resources there is a need to explore and exploit another design for the fabrication of low-cost and innovative additional value devices.[2] Daily life Appliances/equipment requires energy storage devices like battery and supercapacitor. Especially supercapacitors are wanted for power applications and are also largely used for the energy conservation and storage system in sustainable nanotechnology. They get bifurcated on the basis of charge depot tools in two categories, pseudo, and double layer. Interest in supercapacitors because of their high energy capacity, storing for a quicker period and longer lifetime. The ability of charge storage in a supercapacitor depends on the material used for electrode preparation. There are a number of resources like transition metal oxides viz. The following materials are used to fabricate the supercapacitor. RuO_2,[3] V_2O_5,[4] MnO_2,[5] Co_3O_4,[6] CuO,[7] $RuCo_2O_4$, oxyhydroxides such as FeOOH, and CoOOH[8] which are useful in pure or composite forms for the preparation of pseudocapacitive electrodes. Electrically conducting polymers (ECPs) are also being studied for their use as electrode material in pure as well as composite forms for the preparation of supercapacitive electrodes.[9] Further to add the advantages of the double layer the carbon allotropes viz. activated carbon, graphene, carbon nanotubes, *etc* are being studied.[10]

Out of these several materials, the metal oxides are preferable as they have multiple valences beneficial for charge accumulation via faradic redox transitions, produce high specific capacitance, have good electrochemical stability,[11-13] *etc*. Iron oxide has distinctive features viz. ease of production, surface modification via growth control, high specific capacitance, and most of all cost-effective production. Literature shows that iron oxide/oxyhydroxide/hydroxide electrodes for supercapacitor applications have been prepared by various methods viz. SILAR[14,15] chemical vapor deposition,[16] sol–gel,[17,18,20] pulsed laser deposition,[19] a hydrothermal technique,[20] and spray pyrolysis.[18] Films manufactured by these methods normally tend to have little porosity.[21] Iron oxide is a mineral complex that shows different polymorphic forms, including hematite (α-Fe_2O_3), magnetic (Fe_3O_4), and maghemite (γ-Fe2O3). Iron oxide originated in nature in a diverse pattern. Magnetite (Fe_3O_4),

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Potentiodynamic electrodeposited MnO_2:Co_3O_4 thin films electrodes for supercapacitor application

Published: 15 June 2023

Volume 34, article number 1445 (2023) Cite this article

S. V. Khavale, R. C. Ambare, Umesh T. Nakate & B. J. Lokhande

Abstract

The existing research explores the effect of annealing temperature on manganese oxide incorporated cobalt oxide thin films synthesized on stainless steel (SS) using potentiodynamic electrodeposition via aqueous route. Film thickness of synthesized material decreases with increase in annealing temperature. Contact angle measurements show decrease in the hydrophilicity with increase in annealing temperature. XRD of the synthesized samples reveals face centered cubic Co_3O_4 and orthorhombic MnO_2 with polycrystalline nature. FESEM and TEM images display nano-spikes with nano-granu

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Journal of Alloys and Compounds

Volume 884, 25 Nov 2021, 160986

Spray pyrolyzed hydrophilic nickel oxide electrodes with nano-granular morphology for a symmetric supercapacitor device

Shankar G. Randive, Balkrishna J. Lokhande M. ...

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https://doi.org/10.1016/j.jallcom.2021.160986

Abstract

The symmetric supercapacitor device is efficiently invented using two identical sprayed nickel oxide thin film electrodes equipped via an aqueous path. Firstly, we did a comparative study of structural, morphological and electrochemical characterizations of nickel oxide electrodes which are prepared by varying concentrations of the precursors (0.2, 0.4, 0.6, 0.8 and 1.0M and renamed according to their concentration as AC (Aqueous Concentration) AC-1, AC-2, AC-3, AC-4 and AC-5 respectively). XRD patterns of all electrodes confirm cubic crystal structure. The highest value of specific capacitance of *NiO@AC-4* (0.8 M) electrode is 256.32 Fg^{-1} at 0.002 Vs^{-1} which is the maximum among all electrodes. The specific energy and specific power of the AC-4 electrode at 0.002 Acm^{-1} are 29.08 $Whkg^{-1}$ and 3.06 $kWkg^{-1}$ respectively. *NiO@AC-4* electrode shows 69.42% retention in capacitance value after 5000 cyclic voltammetric cycles. The fabricated device parades specific capacitance (SC) 92.81 Fg^{-1} at 0.002 Vs^{-1}. The wettability study depicts the hydrophilic nature of all electrodes (except the *NiO@AC-1* electrode). As concentration increases morphology of the prepared electrodes changes from impenetrable to porous micro globules. SEAD pattern rings and XPS investigation are well matched with XRD analysis.

Graphical Abstract

(https://www.espublisher.com/journals/id/es-energy-environment)

From The Journal

ES Energy & Environment

(https://www.espublisher.com/journals/id/es-energy-environment) Volume 20, 2023
(https://www.espublisher.com/journals/volumearticles/es-energy-environment/2023/volume-20)

Ingredient-Dependent Nickel Oxide Synthesis for Supercapacitor Application

Authors | Authors and affiliations

Shankar G. Randive, H. M. Pathan, and Balkrishna J. Lokhande

Abstract

Due to extraordinary power density and long lifespan supercapacitors possess top priority among all energy storage devices. In this work, we have deposited nickel oxide on the stainless steel by a well-known automatic spray pyrolysis method using different ingredients of nickel for supercapacitor application. The structural, morphological, and cyclic voltammetry (CV) study of the prepared samples was studied using XRD, scanning electron microscopy (SEM), wettability, and cyclic voltammetry. The wettability study gives the contact angle(Θ) of the optimized sample as 63°26′. The X-ray diffraction pattern confirms the formation of nickel oxide. The observed maximum value of Specific Capacitance (SC) is 31.83 Fg^{-1}.

ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

Volume 662, 5 April 2023, 130974

Multifunctional polyoxotungstocobaltate anchored fern-leaf like $BiVO_4$ microstructures for enhanced photocatalytic and supercapacitive performance

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Abstract

In this study, a simple sonochemical approach for molecular anchoring of $CoW_{12}O_{40}$ [12-tungstocobaltate (II)] on fern-leaf like $BiVO_4$ microstructures was employed. The various compositions were prepared by varying contents (0.5%, 1%, 1.5%, 2% and 5%) of $CoW_{12}O_{40}$ (hereafter denoted as CoWO). The as-synthesized samples were characterized and confirmed by various physicochemical tools. Furthermore, the performance of resulting composites was tested toward visible light driven photocatalytic treatment of organic pollutants and supercapacitor. Among them, 1CoWO/BVO composites showed optimal performance as compared to other composites and bare fern-leaf like $BiVO_4$. To be specific, the photocatalytic performance of 1CoWO/BVO showed 97% and 78% degradation of methylene blue dye (MB) and tetracycline drug (TC), respectively. Additionally, the reusability of optimal 1CoWO/BVO photocatalyst was confirmed by performing its five consecutive runs towards degradation of MB and TC. Moreover, 1CoWO/BVO electrode yielded the specific capacitance of 245 Fg^{-1} at 2 mV/s scan rate, supporting its applicability as an efficient supercapacitor electrode. The synergistic effect of CoWO and $BiVO_4$ dominated their bare counterparts towards photocatalytic as well as electrochemical performance. Thus, this work rationally opens up the avenues to employ POMs based novel hybrid materials for future environmental and energy storage application.

Graphical Abstract

ScienceDirect

Materials Chemistry and Physics

Volume 261, 1 February 2021, 127166

Morphologically modified CuO nanorod structure @ stainless steel as high performing supercapacitor electrode prepared by spray pyrolysis

Sandesh V. Kamble, B.J. Lokhande

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Abstract

Copper oxide (CuO) nanorods are successfully grown onto the stainless steel substrates through varying different concentrations of non-aqueous $Cu(NO_3)_2.3H_2O$ by using the spray pyrolysis technique. Structural information and phase formation confirmation are carried out using X-ray diffraction. The as-grown nanorods possess a monoclinic crystal structure with the CuO phase. The growth of nanorods and morphological modifications with different molar concentrations are viewed through field emission scanning electron microscopy. It confirms morphological modifications from randomly oriented nanostructures to well oriented nano-cuboids with the increase in molar concentration of precursor solution. Further transmission electron microscopy confirms the agglomeration of interconnected nanograins to form nano-cuboids. It is observed that specific capacitance increases with an increase in the CuO nanorod size with the molar concentration of the precursor solution. As-prepared CuO electrode exhibits outstanding electrochemical performances with a capacitance of 827.40Fg^{-1}. Encouragingly, morphologically modified CuO nanorod electrode achieves a maximum specific energy of 108.18Whkg^{-1} and outstanding cycling stability with 87.78% capacitive retention after 5000 cycles, which indicates a great potential for practical application. The diffusion coefficient of the electrolyte ions for the high performing CuO electrode is 2.75×10^{-17} cm^{2}s^{-1}, which is suitable for the supercapacitor application.

Graphical abstract

ES Energy & Environment

DOI : https://dx.doi.org/10.30919/esee8c785

Preparation of Magnesium Oxide (MgO) Thin Films by Spray Pyrolysis and Its Capacitive Characterizations

M. T. Mhetre, H. M. Pathan, A. V. Thakur and B. J. Lokhande*

Abstract

Magnesium oxide (MgO) electrodes for the supercapacitor applications have been prepared using automatic spray pyrolysis technique. 100 ml of 1 M aqueous $Mg(NO_3)_2.6H_2O$ solution was sprayed at 2 ml/min. on to the stainless steel (SS) substrate heated to 673 K. The prepared electrodes were analyzed structurally by X-ray Diffraction (XRD) technique, field emission scanning electron microscope (FESEM) analysis, energy dispersive X-ray analysis (EDX), and contact angle measurement, functional group by Fourier transform infrared spectroscopy (FTIR) analysis and electrochemically by cyclic voltammetric analyses (CV), electrochemical impedance spectroscopy (EIS) and the galvanostatic charge discharge (GCD) technique. Different peaks in XRD pattern coincide with the standard database of JCPDS 01-1235 indicating the formation of MgO. The formation of crystalline MgO has further been corroborated by EDX. The formation of MgO was studied the molecular interactions between the metal, oxygen and carbon elements though FTIR analysis. Peaks in the CV curves confirm the redox behavior of the MgO during the CV. The measured specific capacitance (SC) was as high as 202.36 Fg^{-1}. Superb electrochemical stability is observed at 100 mV/s scan rate. Using GCD analyses show different behavior from the normal capacitors. The charging and discharging times were found nearly same for different applied currents. The observed maximum specific capacitance (SC) was 163.55 Fg^{-1} which is comparable with that obtained by CV.

Keywords: Magnesium Oxide; Spray pyrolysis; Contact angle; Supercapacitive study.

Received: 26 April 2022; Revised: 19 September 2022; Accepted: 15 October 2022.

Article type: Communication.

1. Introduction

Climate change and fossil fuel depletion have triggered intense scientific research to explore renewable and sustainable energy Sources; demands from hybrid electric vehicles and pulsed power systems also promote the development of alternative energy.[1-4] The supercapacitor is one of the promising devices to meet the ever-growing need, with its higher energy density than that of common capacitors and better power density than that of batteries.[5] Exploring electrode materials with high specific capacitance (SC) is necessary to improve the energy density of supercapacitors. Carbon materials, conducting polymers and transition metal oxides/ hydroxides with high surface area are commonly used as supercapacitor electrode materials.[6] Carbon based materials (carbon aerogels, carbon nanotubes and graphene)[7-9] as electrode materials for electrical double-layer capacitors have been extensively studied to increase their low SC which directly limited their practical application.[10] Conducting polymers such as polyaniline, polypyrrole, poly(3,4- ethylene dioxy thiophene), etc. have significant drawbacks of low rate of charge discharge due to slow ion diffusion within the bulk of the electrode.[11] Transition metal oxides[12]/hydroxides[13] /sulphides[14] are promising candidates owing to their low environmental toxicity and high SC, which have been widely investigated in an attempt to attain high SC and long cycle life.

Pseudocapacitors/ redox capacitors store the charge via fast faradaic reactions. Redox capacitors are used for high power applications due to quick discharging.[15,16] Variety of materials including not only electrically conducting polymers in pure[17,18] and composite hybrid forms[19,20] but plenty of transition metal oxides (TMO). RuO_2,[21] Co_3O_4,[22] Fe_2O_3,[23] NiO,[24] Fe_3O_4,[25] $FeOOH$,[26-28] $Cu(OH)_2$, $NiCo_2O_4$, $MnCo_2O_4$[29-31] *etc.*, are being tested for fabrication of redox capacitors. Ubiquitous need of alternatives for RuO_2 resulted due to high cost and limited sources of Ru. Although, due to large bandgap of MgO (~7.8 eV) the electrochemical charge storage capability of the MgO is quite less. However, even not belonging to the transition metal oxide group, the MgO has been reported for improving the stability of the electrochemical energy storage electrode materials studied by K. Karthikeyan *et al.*[32]. Also, it produces

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Journal of Alloys and Compounds
Volume 901, 25 April 2022, 162822

Three dimensional hierarchical flower-like CoCuS/$Co_{1-x}Cu_xS$ electrodes for electrochemical supercapacitors

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https://doi.org/10.1016/j.jallcom.2021.162822

Abstract

Recently, the 2021 United nations climate change conference (COP26) have again stressed on the need of carbon neutral economy. To cope up with the power hunger of industrial and/ technological world of hybrid electric vehicles and portable electronic devices it is imperative to search the environment friendly novel materials with property tailoring abilities. In this connection, we have deposited $Co_{1-x}Cu_xS$/CoCuS (0.025≤x≤0.1) thin-films via chemical route as an alternative material for supercapacitor application. To asses the suitability of as-deposited thin films, we have characterized thin films using variety of characterization techniques. X-ray photoelectron spectroscopy was used to examine and confirm the chemical states of Co, Cu, and S. Surface morphology of as-deposited CoCuS film (x=0.075, sample-C_3) showed a crumpled flower-like microstructure. Uniform distribution of hillocks and valleys was observed using atomic force microscopy. The topographical outcomes obtained from electrostatic force microscopy and Kelvin probe force microscopy confirmed that the sample-C_3 (x=0.075) is suitable for energy storage applications. Sample-C_3 demonstrated excellent supercapacitive performance with a high specific capacitance of 907.55 Fg^{-1} at 5 mVs^{-1}, remarkable rate capability, and ~ 90% of capacitive retention after 5000 cycles in a 1 M KOH electrolyte. Better supercapacitive behavior and cycling stability of the CoCuS samples may offer a perspective for various mixed metal sulfide thin films with hierarchical architectures as an viable alternative for the efficient energy storage devices.

Graphical Abstract

Inorganic Chemistry Communications 143 (2022) 109725

Contents lists available at ScienceDirect

Inorganic Chemistry Communications

Journal homepage: www.elsevier.com/locate/inoche

Short communication

Enhanced pseudocapacitive properties of divalent (Mn, Fe, Zn) substituted $NiCo_2O_4$ nanorods

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ARTICLE INFO

Keywords:
$NiCo_2O_4$
Divalent substitution
Nanorods
Hydrothermal
Supercapacitor

ABSTRACT

We report the electrochemical performance of divalent (Mn, Fe, Zn) substituted $NiCo_2O_4$ nanorods, developed using facile hydrothermal route. The physico-chemical properties of the electrode materials were analysed using XRD, FESEM, TEM, HRTEM, FFT, EDAX and XPS. The performance of Mn substituted $NiCo_2O_4$ was found to be the best divalent replacement, with a specific capacitance of 1272 F/g at 1 A/g current density, an energy density of 35.77 Wh/kg, and a power density of 660.39 W/kg. The capacitance of Fe and Zn substituted $NiCo_2O_4$ was found to be lower than that of the pure $NiCo_2O_4$ electrode material, which may be owing to the lower catalytic activity of Fe and Zn. The Mn substituted $NiCo_2O_4$ demonstrates that it has the potential to be used as a high performance supercapacitor in practical applications.

1. Introduction

In recent decades, the energy demand has increased a lot, due to the speedy growth of industrialization and thereby the economy. Furthermore, decreasing the dependency on fossil fuels encouraged the developments of new energy storage and conversion technologies in view of environmental friendly energy sources. All electrochemical systems, such as lithium-ion, lead-acid, nickel metal hydride, metal-air, and next-generation batteries and supercapacitors are becoming more popular in order to gap-down the energy demand [1–6]. In comparison, supercapacitors have fascinating properties such as high energy density, high power (>10 kW/kg), ability of fast charge/discharge, and long cycle life (10^6 cycles). These properties ensure outstanding possibilities to portable electronic devices i.e. automotive/hybrid electric vehicles, digital telecommunication systems, uninterrupted power supply for computers, and many more [6,7]. Generally, supercapacitors are of two types: electrical double-layer capacitors (EDLCs) and pseudocapacitors (PCs). These supercapacitors include three major categories of materials as: carbonaceous materials, conducting polymers and transition metal oxides/hydroxides, depending on their different charge storage mechanisms [8,9]. The various metal oxides including MnO_2 [10], NiO [11], Co_3O_4 [12], V_2O_5 [13], and MoO_3 [14] are pseudocapacitive materials, which broadly used because of their increasing specific capacitance, energy density and power density. However, for the practical application, single metal oxides have limitation to enhance the supercapacitive properties due to their poor electrical conductivity and large volume expansion. Therefore, additional conductive phases in the pristine material, are needed to improve the electrochemical properties, and thereby supercapacitive values.

Recently, binary or ternary transition metal oxides have attracted extensive attention because of their outstanding electrochemical performance and electrical conductivity compared with the single-metal oxides. Now-a-days, binary metal oxides, such as nickel cobaltite ($NiCo_2O_4$) [15,16], $CoMoO_4$ [17] and $NiMnO_3$ [18] have been reported to exhibit better electrochemical performance than single metal oxides due to their high electrical conductivity. Singh et al. [19] reported that the Co_3O_4-MnO_2-NiO supercapacitor with excellent specific capacitance (2525 Fg^{-1}), and high retention (80%) after 5700 cycles. Furthermore, Zhang et al. reported Zinc Nickel-Cobalt Oxide @ $Ni(OH)_2$ supercapacitors with ultrahigh specific capacitance 2847.5 Fcm^{-3} [20].

The motivation of this work is to develop such pseudocapacitor with enhanced supercapacitive properties by the substitution of divalent

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https://doi.org/10.1016/j.inoche.2022.109725
Received 24 May 2022; Received in revised form 22 June 2022; Accepted 23 June 2022
Available online 27 June 2022

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Article

Spinel Magnesium Ferrite ($MgFe_2O_4$): A Glycine-Assisted Colloidal Combustion and Its Potentiality in Gas-Sensing Application

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Abstract: Herein, we describe the facile synthesis of spinel $MgFe_2O_4$ ferrite and its potential use as a gas sensor using a straightforward and reliable sol–gel approach, i.e., the glycine-assisted auto-combustion route. The novelty in obtaining the sensing material via the auto-combustion route is its inherent simplicity and capability to produce the material at an industry scale. The said cost-effective process makes use of simple metal salts (Mg and Fe-nitrates) and glycine in an aqueous solution, which leads to the formation of spinel $MgFe_2O_4$ ferrite. A single-phase crystallinity with crystallite sizes ranging between 36 and 41 nm was observed for the synthesized materials using the X-ray diffraction (XRD) technique. The porous morphologies of the synthesized materials caused by auto-ignition during the combustion process were validated by the microscopic investigations. The EDS analysis confirmed the constituted elements such as Mg, Fe, and O, without any impurity peaks. The gas-sensing ability of the synthesized ferrites was examined to detect various reducing gases such as LPG, ethanol, acetone, and ammonia. The ferrite showed the highest response (>80%) toward LPG with the response and recovery times of 15 s and 23 s, respectively. Though the sensor responded low toward ammonia (~30%), its response and recovery times were very quick, i.e., 7 s and 9 s, respectively. The present investigation revealed that the synthesized ferrite materials are good candidates for fabricating high-performance sensors for reducing gases in real-world applications.

Keywords: $MgFe_2O_4$; glycine combustion; gas sensors; reducing gases

Citation: Nadargi, D.; Umar, A.; Nadargi, J.; Patil, J.; Mulla, I.; Akbar, S.; Suryavanshi, S. Spinel Magnesium Ferrite ($MgFe_2O_4$): A Glycine-Assisted Colloidal Combustion and Its Potentiality in Gas-Sensing Application. *Chemosensors* **2022**, *10*, 361. https://doi.org/10.3390/chemosensors10090361

Academic Editor: Marco Frasconi

Received: 2 August 2022
Accepted: 5 September 2022
Published: 9 September 2022

1. Introduction

In a globalized automated life style, sensors play a key role in the comfort-with-safety segment of human life. In the IoT (Internet of Things) development and extensive use in smart home and smart city programs, sensors are directing other technologies to improve the quality of life of individuals across the globe. Traditionally, gas sensors were restricted to the detection of accidental discharge of gases in the industry sector and leak detection in households. A growing challenge of environmental sustainability due to pollution and increased greenhouse gas emissions led to the development of gas sensor research and development. However, a new ecosystem for environmental monitoring is being made possible by a fresh wave of miniaturization and cost reduction in the gas sensor industry. The value of this asset, according to analysts at ID-Tech Ex, is expected to be USD 361 million in 2017, USD 2.4 billion in 2022, and more than USD 3 billion in 2027 [1]. In view of this, amongst the various gas sensors such as electrochemical sensors, metal oxide

J Mater Sci (2023) 58:559–582

Review

Gas sensors and factors influencing sensing mechanism with a special focus on MOS sensors

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Received: 21 August 2022
Accepted: 7 December 2022
Published online: 1 January 2023

ABSTRACT

Industrialization and its progress are very important for the economy and to move towards prosperity, stimulating innovation and creating jobs. Nonetheless, industrialization has negative impacts, if not done judiciously, such as pollution, increased greenhouse gas emissions, and global warming. Therefore, amenity-with-security is of fundamental significance in a new and dynamic lifestyle. A gas sensor is one of the crucial devices for monitoring and subsequently preserving the clean atmosphere among a number of other safety technologies. In-depth assessments of gas sensors and their necessity in the environment (air) pollution are provided in the current review. With a special emphasis on metal oxide semiconductor (MOS)-based gas sensors, the review includes a thorough study of gas sensors and the factors relating to sensing mechanisms. It not only describes the basic concepts and brief history of gas sensors, but also highlights the schemes responsible for improving the gas sensing properties and state-of-art literature review. These schemes include (1) surface engineering/morphological tuning and (2) bulk and surface doping. To keep scientific rigour and in-depth analyses, this review focuses on these two schemes only. In the doping area, the emphasis is given on graphene loading, decorated with nanoparticles of noble metals, spillover mechanism, and heterojunction (p–n, n–n, and p–p) formation. The conclusion summarizes the most optimized MOS gas sensors with enhanced gas sensing capabilities. The

Handling Editor: Pedro Camargo.

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https://doi.org/10.1007/s10853-022-08072-0

Ceramics International 49 (2023) 5738–5747

Contents lists available at ScienceDirect

Ceramics International

Journal homepage: www.elsevier.com/locate/ceramint

Pd loaded bismuth ferrite: A versatile perovskite for dual applications as acetone gas sensor and photocatalytic dye degradation of malachite green

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ARTICLE INFO

Keywords:
Bismuth ferrite
Palladium loading
Acetone sensor
Photo dye-degradation

ABSTRACT

Herein we report the palladium loaded bismuth ferrite for its bidirectional application as acetone gas sensor and photocatalytic dye degradation of malachite green. The motivation for loading Pd on bismuth ferrite (BFO) is due to its fascinating catalytic redox reactions causing faster adsorption and desorption of the oxygen molecules over the metal oxide. The planned perovskites were developed via surfactant assisted sol-gel auto-combustion route, and characterized their physico-chemical properties using XRD, SEM, TEM, HRTEM, EDAX, XPS and BET. The developed BFO showed the best selectivity towards acetone, whose response was 69% at 300 °C operating temperature for 500 ppm gas concentration. By tuning the surface area and catalytic behavior using CTAB and Pd loading, respectively, the enhancement in the gas response properties of BFO was achieved to 95% with the response and recovery time of 75 s and 104 s. The 1 wt% Pd loaded BFO showed the highest response (95%) in comparison to rest of the Pd loadings (0.5, 1.5 and 2.0 wt%). Moreover, the sunlight driven photocatalytic dye degradation of malachite green is carried out at 1 h exposure time. Here as well, 1 wt% Pd loaded BFO exhibited the maximum dye degradation efficiency of 51%. The results of this study demonstrate the developed perovskites have a significant potential for the use in dual applications such as acetone gas sensor and MG photocatalysis.

1. Introduction

In recent years, perovskites have sparked considerable interest in materials science and engineering due to their high stability, tunable structure/chemical composition, and high catalytic properties. In addition, their ability to host the cationic and plentiful oxygen vacancies endows superior electrical and redox properties that influence their overall performance and reliability [1]. The cubic structure of perovskites with the stoichiometry ABO_3 may be described as: the larger cation A at each corner of the unit cell, and the smaller cation B at the body center sites, are 12- and 6-fold, coordinated with oxygen anions at the face center sites. With precisely matched A-O and B-O bond lengths, the tolerance factor determines the sizes of A and B. The tolerance factor has a value of unity, when the A-O and B-O bond lengths are perfectly matched. A-site cation at the dodecahedral position typically donates electrons to the $[BO_6]$ octahedral, while the B-site cation at the dodecahedral site alters the electronic structure; hence affecting the physical properties of the perovskite oxide.

Therefore, these ternary oxides open-up the research tool box for gas sensing and photocatalytic applications in particular, and getting attention compared to binary metal oxides such as SnO_2, NiO, WO_3, TiO_2, and ZnO [2–6]. Amongst the varieties of ABO_3 perovskites (i.e. $PbTiO_3$, $BaTiO_3$, $LaMnO_3$, $BiFeO_3$, $LaFeO_3$, $PrFeO_3$), bismuth ferrite ($BiFeO_3$ or BFO) exhibits unique surface reaction properties, ease oxygen absorption, and relatively small band gap (2.19 eV), which are beneficial for the industrial applications such as information storage devices, photovoltaics, photocatalytic, spintronic, sensors, and many more [7–10]. In the state of art, diverse array of applications of $BiFeO_3$ does exist. However, to the best of our knowledge, very few reports are available that showcase its gas sensing as well as photocatalytic dye

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https://doi.org/10.1016/j.ceramint.2022.10.153
Received 4 July 2022; Received in revised form 14 September 2022; Accepted 10 October 2022
Available online 13 October 2022

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Article

One-Pot Sol–Gel Synthesis of Highly Insulative Hybrid P(AAm-CO-AAc)-Silica Aerogels with Improved Mechanical and Thermal Properties

Akshay A. Ransing [1], Rushikesh P. Dhavale [1], Vinayak G. Parale [1], Uzma K. H. Bangi [2], Haryeong Choi [1], Wonjun Lee [1], Jiseung Kim [1], Qi Wang [1], Varsha D. Phadtare [1], Taehee Kim [1], Wook Ki Jung [3] and Hyung-Ho Park [1,*]

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Abstract: Silica aerogels and their derivatives have outstanding thermal properties with exceptional values in the thermal insulation industry. However, their brittle nature restricts their large-scale commercialization. Thus, enhancing their mechanical strength without affecting their thermal insulating properties is essential. Therefore, for the first time, highly thermally stable poly(acrylamide-co-acrylic acid) partial sodium salt is used as a reinforcing polymer to synthesize hybrid P(AAm-CO-AAc)-silica aerogels via epoxy ring-opening polymerization in the present study. Functional groups in P(AAm-CO-AAc) partial sodium salts, such as $CONH_2$ and COOH, acted as nucleophiles for the epoxy ring-opening reaction with (3-glycidyloxypropyl)trimethoxysilane, which resulted in a seven-fold enhancement in mechanical strength compared to that of pristine silica aerogel while maintaining thermal conductivity at less than 30.6 mW/mK and porosity of more than 93.68%. Moreover, the hybrid P(AAm-CO-AAc)-silica aerogel demonstrated improved thermal stability up to 343 °C, owing to the synergetic effect between the P(AAm-CO-AAc) and the silica aerogel, corresponding to the thermal stability and strong covalent bonding among them. These excellent results illustrate that this new synthetic approach for producing hybrid P(AAm-CO-AAc)-silica aerogels is useful for enhancing the mechanical strength of pristine silica aerogel without impairing its thermal insulating property and shows potential as an industrial heat insulation material.

Keywords: one-pot sol–gel synthesis; hybrid P(AAm-CO-AAc)-silica aerogel; epoxy ring-opening polymerization; thermal stability; mechanical properties

Citation: Ransing, A.A.; Dhavale, R.P.; Parale, V.G.; Bangi, U.K.H.; Choi, H.; Lee, W.; Kim, J.; Wang, Q.; Phadtare, V.D.; Kim, T.; et al. One-Pot Sol–Gel Synthesis of Highly Insulative Hybrid P(AAm-CO-AAc)-Silica Aerogels with Improved Mechanical and Thermal Properties. *Gels* **2023**, *9*, 651. https://doi.org/10.3390/gels9080651

Academic Editor: Guanglei Zhang

Received: 18 July 2023
Revised: 7 August 2023
Accepted: 9 August 2023
Published: 12 August 2023

1. Introduction

In recent years, the heat insulation industry has paid a great deal of attention to silica aerogels due to their noteworthy properties, such as very low density (0.03–0.1 g/cm^3), high porosity (90–99%), high specific surface area (100–1000 m^2/g), and low thermal conductivity (0.02–0.044 W/mK) [1–5]. Moreover, their fascinating properties make them suitable for a wide range of applications in aerospace and other industries, including sensors, building construction, super-insulated windows, and energy storage devices [6–12]. However, besides the outstanding properties of silica aerogels, their brittle and fragile nature constrains their long-term and practicability for heat insulation. Therefore, to overcome these shortcomings of silica aerogels, researchers are currently focused on enhancing their mechanical strength without affecting their intrinsic properties [13–15].

Journal of Porous Materials
https://doi.org/10.1007/s10934-023-01500-9

Improvement in the characteristics of ambient pressure dried silica aerogels for thermal insulation purpose

Uzma K.H. Bangi[1] · Akshay A. Ransing[2] · Rushikesh P. Dhavale[2] · Hyung-Ho Park[2] · Vikas B. Patil[1]

Accepted: 29 June 2023

Abstract
Experimental work was carried out to improve the characteristics of ambient pressure dried silica aerogels for thermal insulation purpose. The type of sol-gel method and silylating agent used determines the quality of the produced aerogels. Therefore, a two-step sol-gel method was used to synthesize sodium silicate-based aerogels, and silylation was conducted with trimethylchlorosilane (TMCS). The molar ratio of sol-gel parameters utilised for silica aerogel synthesis was set to Na_2SiO_3:H_2O(B):H_2O(A)::1:0.169:0.113 containing 3 wt% silica, 2 M NH_4F, and 4 M HCl. And the effect of varying TMCS percentage on aerogel properties was investigated. Various characterizations techniques such as FTIR spectroscopy, FESEM, BET analyses and TGA-DSC etc. have been used to study the characteristics of aerogels. The FTIR spectra of the aerogels revealed an increase in the bond intensities of the C-H and Si-C peaks with rise in the percentage of TMCS. According to the BET analysis and FESEM imaging, the aerogels prepared using 33.3% TMCS exhibited narrow pore size distribution and homogenous tiny particles respectively. Furthermore, these aerogels possessed improved visual optical transmission, 0.11 g/cc density, 0.129 W/mK thermal conductivity, 331 kJ/m^{3}K specific heat capacity, 93.6% porosity, water contact angle of 143°, 591 m^2/g surface area, and pore size of 71.42 Å. TGA-DSC studies indicated that these aerogels retain their hydrophobicity up to 445 °C. After observing the thermal insulating property of these aerogels in the lab, it was determined that they can be used for thermal insulation.

Keywords Two step sol-gel process · TMCS percentage · Ambient pressure drying · Silica aerogels · Thermal insulation purpose

1 Introduction

Silica aerogels are obtained by replacing the liquid present in pores of a gel with air via supercritical drying or freeze drying or ambient pressure drying methods. These are the lightest solid foams composing a network of interconnected nanostructure. They possess unique material properties such as low density (~0.03 g/cc), thermal conductivity (~0.017 W/mK), high porosity (~99.8%) as well as large surface area (~1000 m^2/g) [1–3]. With such remarkable properties, aerogels create a wide scope of applications in various technological areas viz. space, building and construction, household, automobile industry, nuclear power plant, textile industry, food industry as well as medical field etc. [4–6]. Hence, owing to their unique properties, aerogels can be easily and efficiently applied for better results in every field with low cost. Low thermal conductivity of silica aerogels makes them a very economical and practical insulating material used in different industries and areas as mentioned above. The study of heat transfer through aerogels has created interest in scientists to characterize their thermal properties and to appreciate the insulating power. In this context, Gunay et al. have synthesized optically transparent silica aerogels for solar thermal insulation [7]. Yoda et al. reported the development of silica aerogel – polypropylene foam composite sheets for flexible thermal insulation [8]. Moreover, the preparation of dense and strong super- insulating silica aerogels has been carried out by Iswar et al. [9]. All these researchers have employed the CO_2 supercritical drying

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Published online: 10 July 2023

Sodium Silicate-Based Aerogels by Ambient Pressure Drying

16

A. Venkateswara Rao, Shanyu Zhao, Gerard M. Pajonk, Uzma K. H. Bangi, A. Parvathy Rao, and Matthias M. Koebel

Contents

Abstract

Silica aerogels are the most commercially relevant aerogel materials. By volume, supercritically dried blanket composites are still leading global sales by a substantial amount; however, particle-based aerogels such as granulate and powder are cost-competitive alternatives. This chapter summarizes the last three decades of research and industrial process development in the field of "low-cost," sodium silicate-based aerogel preparation by means of ambient pressure drying, illustrating key developments and milestones in both academic research and process engineering fields. Key process steps such as gelation, aging, hydrophobization, and APD drying are analyzed in detail in the context of feasibility, simplicity, product quality, and scalability. The chapter finishes with a brief discussion of key process parameters and their effect on the physical properties of the obtained aerogel materials as well as a current snapshot of the most promising applications for particle-based aerogels.

Keywords

Sodium silicate · Waterglass · Ambient pressure drying · Hydrophobization · Parameter optimizations · Commercialization

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16.1 Introduction

Commercially available aerogel materials today are primarily of the silica variety. The importance of this particular chemistry rests on two main pillars, namely the availability of inexpensive silica precursors and compatible silane hydrophobes as well as their early scientific discovery and academic relevance. Silica aerogels were first prepared by S. S. Kistler at the College of the Pacific, in 1931, using sodium silicate as a precursor and supercritical drying [1]. However, the more elaborate and time-consuming supercritical drying procedure, coupled with the discovery of simpler preparation routes for porous silicates,

M. A. Aegerter et al. (eds.), *Springer Handbook of Aerogels*, Springer Handbooks,
https://doi.org/10.1007/978-3-030-27322-4_16

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Hydrous and Amorphous Cobalt Phosphate Thin-Film Electrodes Synthesized by the SILAR Method for High-Performing Flexible Hybrid Energy Storage Devices

Vinod V. Patil, Sachin S. Pujari, Shraddha B. Bhosale, Sambhaji S. Kumbhar, Vinayak G. Parale, Jayavant L. Gu… okhande, Mukund G. Mali, Dattakumar S…

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Cite this: *Energ…*
Publication Date: …
https://doi.org/10.…

SI Supporting Info (1) »

SUBJECTS: Capacitors, Cobalt, Electrical properties, Electrodes, Phosphates

Polycyclic Aromatic Compounds ›
Volume 43, 2023 - Issue 7

Research Articles

A Novel Recyclable Bi-Mg-O Composite Nano-Catalyst Promoted Rapid and Efficient Synthesis of Spirooxindole and 4H-Pyran Derivatives

Abhijeet Mulik, Vishvanath Ghanwat, Mukund Mali, D.-Y. Kim, Dae Sung Lee, ...s

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Pages 6665-6678 | Receiv... e: 25 Sep 2022

Abstract

A novel Bi-Mg-O composite nano-catalyst was prepared by using $Bi(NO_3)_3$ and nano-MgO. Prepared catalyst was characterized using x-ray diffraction (XRD) analysis, scanning electron microscope (SEM), X-ray photoelectron spectroscopy (XPS) technique which confirms its nano-crystalline nature and composition. The synthesized novel catalyst Bi-Mg-O was found to be competent catalyst for the s...hesis of spirooxindole derivatives by multicomponent reaction of isatin, ...done, malononitrile and 4H-pyran derivatives by reaction of dimedone, aryl

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Colloids and Surfaces A: Physicochemical and Engineering Aspects

Volume 662, 5 April 2023, 130974

Multifunctional polyoxotungstocobaltate anchored fern-leaf like $BiVO_4$ microstructures for enhanced photocatalytic and supercapacitive performance

Gopal Mali [a], Laxman Walekar [b], Nagesh Kolhe [b], Abhijit N. Kadam [c f], Rohan Kore [d], Dattakumar Mhamane [e], Harichandra Parbat [f], Sang-Wha Lee [c], Balkrishna Lokhande [d], Vaishali Patil [g], Gavisiddapa Gokavi [a], Mukund Mali [b]

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https://doi.org/10.1016/j.colsurfa.2023.130974

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Abstract

In this study, a simple sonochemical approach for molecular anchoring of $CoW_{12}O_{40}$ [12-tungstocobaltate (II)] on fern-leaf like $BiVO_4$ microstructures was employed. The various compositions were prepared by varying contents (0.5%, 1%, 1.5%, 2% and 5%) of $CoW_{12}O_{40}$ (hereafter denoted as CoWO). The as-synthesized samples were characterized and confirmed by various physicochemical tools. Furthermore, the performance of resulting composites was tested toward visible light driven photocatalytic treatment of organic pollutants and supercapacitor. Among them, 1CoWO/BVO composites showed optimal performance as compared to other composites and bare fern-leaf like $BiVO_4$. To be specific, the photocatalytic performance of 1CoWO/BVO showed 97% and 78% degradation of methylene blue dye (MB) and tetracycline drug (TC), respectively. Additionally, the reusability of optimal 1CoWO/BVO photocatalyst was confirmed by performing its five consecutive runs towards degradation of MB and TC. Moreover, 1CoWO/BVO electrode yielded the specific capacitance of $245\,Fg^{-1}$ at 2 mV/s scan rate, supporting its applicability as an efficient supercapacitor electrode. The synergistic effect of CoWO and $BiVO_4$ dominated their bare counterparts towards photocatalytic as well as electrochemical performance. Thus, this work rationally opens up the avenues to employ POMs based novel hybrid materials for future environmental and energy storage application.

Graphical Abstract

ScienceDirect

Case Studies in Chemical and Environmental Engineering

Volume 8, December 2023, 100380

Case Report

Surface plasmon resonance based colorimetric probe for vitamin B_1 detection: Applications to bio-fluid analysis

Uttam R. Kondekar [a], Laxman S. Walekar [b], Samadhan P. Pawar [a c], Mukund G. Mali [b], Dilip D. Anuse [d], Chandrakant G. Gardi [e], Shamkumar Deshmukh [f], Prashant V. Anbhule [a], Govind B. Kolekar [a]

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https://doi.org/10.1016/j.cscee.2023.100380

Abstract

This study reports simple analytical approach for thiamine (Vitamin B_1) detection based on induced aggregation and alternation in colorimetric properties of gold nanoparticles (AuNPs), which was synthesized through citrate reduction approach. Furthermore, the citrate capped AuNPs are characterized by various analysing tools. The addition of thiamine persuades the aggregation of citrate-AuNPs and further leading to red to blue colour transition with decrease in absorbance intensity. The proposed method achieves good linearity with a correlation coefficient of 0.9843. By using our proposed strategy, thiamine was detected by unassisted vision as well as absorption spectroscopy. Under the most favorable condition method achieves good linear relationship between concentration range 0.01–0.8 $\mu g mL^{-1}$ with limit of detection of 0.0067 $\mu g mL^{-1}$. Under the premium condition, the method offers excellent selectivity towards thiamine detection in presence of different interfering species. Further practical applicability of the method was checked by using blood serum and urine sample via standard addition method. The obtained recoveries were acceptable in the range of 98.70–102.97% for added thiamine concentration. Thus, the proposed method may emerge as a target specific and highly sensitive tool towards thiamine detection.

Previous Next

Keywords

Gold nanoparticles; Thiamine; Aggregation; Colour change; Bio-fluids; SPR; Absorption

1. Introduction

Vitamins are one of the most required micronutrient for human body to work properly. Anabolic processes do not produce some vitamins, food and medicines are good candidate to provide it [1]. B complex is a combination of Vitamin B_1, B_6 and B_{12} and important participant in various functions of metabolism and excess or deficiency of

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Journal of Molecular Structure

Volume 1261, 5 August 2022, 132903

3-Substituted-2-oxindole derivatives: Design, synthesis and their anti-tuberculosis and radical scavenging dual-action studies

Mahesh Hublikar [a], Vikas Kadu [a], Dattatraya Raut [a], Sachin Shirame [a], Sivaraj Anbarasu [b], Muhanna K. Al-Muhanna [c], Parameshwar Makam [d e], Raghunath Bhosale [a]

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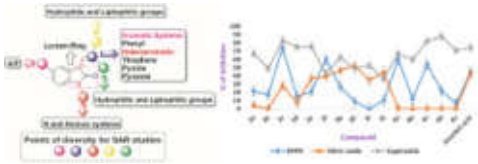
Abstract

Despite the fact that the oxindole has long been thought to be the best structural scaffold, research shows that oxindole derivatives are being studied the least against tuberculosis (TB), a historically airborne illness. The present research focuses on the development of 3-substituted-2-oxindole derivatives with a combination of structural and functional alterations in order to create dual-active new chemical entities with anti-TB, anti-oxidant, and radical-scavenging properties. The physicochemical properties of these compounds are in line with the theories of Lipinski, Veeber, and Leeson. SWISSADME was used to assess the drug-like molecular nature and pharmacokinetics features. Multistep synthetic procedures were used to synthesise the chemicals. Based on *in vitro* anti-TB and radical scavenging property analyses, the synthesised 3-substituted-2-oxindole derivatives were confirmed as dual-active compounds. The synthesised 3-substituted-2-oxindole derivatives were confirmed to possess the dual therapeutics action. The discovery of radical scavengers **4d, 4a, 4c, 3d, 3c, 3f, 3e, 3h, 3g,** and **3j** that are more potent than Ascorbic acid, the standard. The molecules, **3c, 3j, 3b,** and **4b** have exhibited moderate to active anti-TB properties with a % reduction values of 46.42%, 40.89%, 39.76% and 39.32%, respectively. The findings suggest that fine-tuning molecules might result in compounds with better anti-TB and radical-scavenging properties.

Graphical abstract



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Polycyclic Aromatic Compounds ›
Volume 42, 2022 - Issue 7

Research Articles

Green Synthesis, Molecular Docking, *In Silico* ADME and Biological Evaluation of Methoxy Substituted 1,5-Benzodiazepines as Potential Antioxidant, Anti-Inflammatory, and Antidiabetic Agents

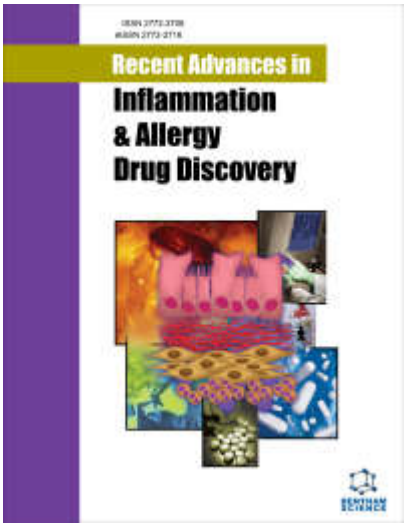
Nargisbano A. Peerzade, **Shravan Y. Jadhav**, Bhushan D. Varpe, Amol A. Kulkarni & Raghunath B. Bhosale

Pages 3939-3952 | Received 23 Mar 2020, Accepted 12 Jan 2021, Published online: 08 Feb 2021

Cite this article https://doi.org/10.1080/10406638.2021.1878244 Check for updates

Abstract

Present work involves the green and environmentally benign synthesis of 1,5-benzodiazepines using iodine as a catalyst and PEG-400 as a green solvent at room temperature that gives an excellent yield of products. All the synthesized compounds were screened for their anti-inflammatory, antioxidant, and antidiabetic activity. All the synthesized compounds showed excellent antioxidant activity against DPPH and



Syntheses, Molecular Docking and Biological Evaluation of 2-(2- hydrazinyl)thiazoles as Potential Antioxidant, Anti-Inflammatory and Significant Anticancer Agents

Authors: Raut, Dattatraya G.; Bhosale, Raghunath B.; Lawand, Anjana S.; Hublikar, Mahesh G.; Kadu, Vikas D.; Patil, Sandeep B.; Choudhari, Prafulla B.
Source: Recent Advances in Inflammation & Allergy Drug Discovery, Volume 16, Number 2, 2022, pp. 96-106(11)
Publisher: Bentham Science Publishers
DOI: https://doi.org/10.2174/2772270816666220902094019

Abstract | References | Citations | Supplementary Data

Background: Recently, researchers have worked on the development of new methods for the synthesis of bioactive heterocycles using polyethylene glycol as a green solvent. In this context, we report the synthesized 2-(2-hydrazinyl) thiazoles for their in vitro antioxidant, in vitro anti-inflammatory and in vitro anti-cancer activities.

Objective: The objective of the study was to develop novel antioxidant, anti-inflammatory and anti-cancer drugs.

Methods: At the outset, the condensation of substituted acetophenones 1, thiosemicarbazide 2, and α-haloketones 3 was carried out using PEG-400 (20 mL) in the presence of 5 mol% glacial acetic acid to afford thiosemicarbazones intermediate. Furthermore, these thiosemicarbazones were reacted with α-haloketones 3 to obtain appropriate 2-(2-hydrazinyl) thiazoles. The synthesized compounds were in vitro tested for their antioxidant, anti-inflammatory, and anti-cancer activity.

Effect of embedding aluminium and yttrium on the magneto-optic properties of lanthanum spinel ferrite nanoparticles synthesised for photocatalytic degradation of methyl red

Original Paper: Nano-structured materials (particles, fibres, colloids, composites, etc.)
Published: 08 October 2022

Volume 104, pages 354–364, (2022) Cite this article

Subiya K. Kazi, Radhakrishnan M. Tigote, Vandana A. Gaikwad, Dhanraj P. Kamble, Pravin S. Bhale, Sadanand N. Shringare, Pramod G. Musrif & Shaukatali N. Inamdar

Abstract

The sol-gel approach was used to synthesise lanthanum and aluminium doped yttrium ferrite nanoparticles. The absorption peak is observed at ~265 nm corresponds to band gap of 2.9–3.1 eV. X-ray diffraction (XRD), field emission scanning electron microscopy (FE-SEM) and High-Resolution Transmission Electron Microscopy (HR – TEM) were used to analyse the structural and microstructural properties of the product. The particle size calculated to be 60–110 nm from the HR-TEM analysis. The vibrating sample

ChemistrySelect / Volume 7, Issue 22 / e202104028

Review

Recent Advances for Synthesis of Oxazole Heterocycles *via* C-H/C-N Bond Functionalization of Benzylamines

Dr. Vikas D. Kadu

First published: 09 June 2022
https://doi.org/10.1002/slct.202104028
Citations: 6

Graphical Abstract

The five membered heteroaromatic oxazole motifs and their scaffolds exhibit significant pharmaceutical and biological applications. Remarkably, the high efficiency in the assembly of structurally diverse oxazole scaffolds *via* C(sp^3)-*H* functionalization of benzylamines have attracted synthetic organic chemists. In this review, the different synthetic strategies from benzylamines as a new emerging substrate *via* C−H/C−N bond functionalization towards oxazole synthesis are discussed in detail. Moreover, it highlights substrate scope along with the reaction mechanism involved during the reaction.

ScienceDirect

Journal of Molecular Structure

Volume 1267, 5 November 2022, 133502

Oxone-Promoted Synthesis of Bis(indolyl)methanes from Arylmethylamines and Indoles

Vikas D. Kadu, Amruta A. Patil, Prajakta R. Shendage

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Abstract

An environmentally benign synthesis of 3,3'-bis(indolyl)methanes (BIMs) has been developed from arylmethylamines and indoles under aerobic condition in presence of oxone. The formation of BIMs using ethanol as a green reaction medium represents a good practical method for synthesis. The good tolerance was observed towards various functional groups for exploring substrate scope in presence of oxone and the synthesized BIMs afforded in excellent yields up to 94%.

Graphical Abstract

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Introduction

Indoles are well-known nitrogen containing heterocyclic scaffolds due to huge significance in the field of medicinal chemistry [1], [2], [3], [4], [5], [6], [7]. It has broad range of applications in alkaloids, pharmaceuticals, natural products [7], agrochemicals, hormones and neurotransmitters [8]. Especially, bis(indolyl)methanes (BIMs) and tris(indolyl)methanes have been recognized as core motif in natural products and pharmaceutical science. [9,10] It's occurrence in different terrestrial and marine natural resources has increased the biological importance [11], [12], [13], [14]. In addition, the substituted tetraphenylethylene scaffolds of BIMs have shown the properties of AIE active

Asian Journal of Organic Chemistry / Volume 11, Issue 8 / e202200388

Cover Picture | Free Access

Cover Feature: Rapid One-Pot Aerobic Oxidative *N*-α-C(sp^3)-*H* Functionalization of Arylmethylamines to Access Tetrasubstituted Imidazoles (Asian J. Org. Chem. 8/2022)

Dr. Vikas D. Kadu, Siddheshwar P. Khadul, Gokul J. Kothe, Ganesh A. Mali

First published: 01 August 2022
https://doi.org/10.1002/ajoc.202200388

Graphical Abstract

A simple copper-catalyzed "one-pot" process has been developed for the synthesis of poly-substituted imidazoles. Tetrasubstituted imidazoles could be afforded in short reaction time and in excellent yields under mild and eco-friendly conditions *via* direct oxidative *N*-α-C(sp^3)-*H* functionalization of arylmethylamines. The explored substrate scope of readily available benzylamines with 1,2-diketones and α-hydroxyketones has shown great utility in designing different tetrasubstituted imidazole scaffolds that are of medicinal significance through this alternative route. More information can be found in the **Research Article by Vikas D. Kadu et al**.

ScienceDirect

Journal of Molecular Structure

Volume 1261, 5 August 2022, 132903

3-Substituted-2-oxindole derivatives: Design, synthesis and their anti-tuberculosis and radical scavenging dual-action studies

Mahesh Hublikar [a], Vikas Kadu [a], Dattatraya Raut [a], Sachin Shirame [a], Sivaraj Anbarasu [b], Muhanna K. Al-Muhanna [c], Parameshwar Makam [d e], Raghunath Bhosale [a]

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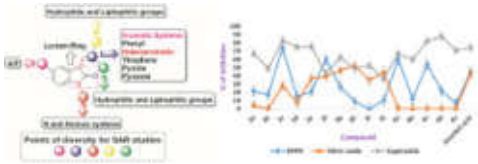
Abstract

Despite the fact that the oxindole has long been thought to be the best structural scaffold, research shows that oxindole derivatives are being studied the least against tuberculosis (TB), a historically airborne illness. The present research focuses on the development of 3-substituted-2-oxindole derivatives with a combination of structural and functional alterations in order to create dual-active new chemical entities with anti-TB, anti-oxidant, and radical-scavenging properties. The physicochemical properties of these compounds are in line with the theories of Lipinski, Veeber, and Leeson. SWISSADME was used to assess the drug-like molecular nature and pharmacokinetics features. Multistep synthetic procedures were used to synthesise the chemicals. Based on *in vitro* anti-TB and radical scavenging property analyses, the synthesised 3-substituted-2-oxindole derivatives were confirmed as dual-active compounds. The synthesised 3-substituted-2-oxindole derivatives were confirmed to possess the dual therapeutics action. The discovery of radical scavengers **4d, 4a, 4c, 3d, 3c, 3f, 3e, 3h, 3g,** and **3j** that are more potent than Ascorbic acid, the standard. The molecules, **3c, 3j, 3b,** and **4b** have exhibited moderate to active anti-TB properties with a % reduction values of 46.42%, 40.89%, 39.76% and 39.32%, respectively. The findings suggest that fine-tuning molecules might result in compounds with better anti-TB and radical-scavenging properties.

Graphical abstract



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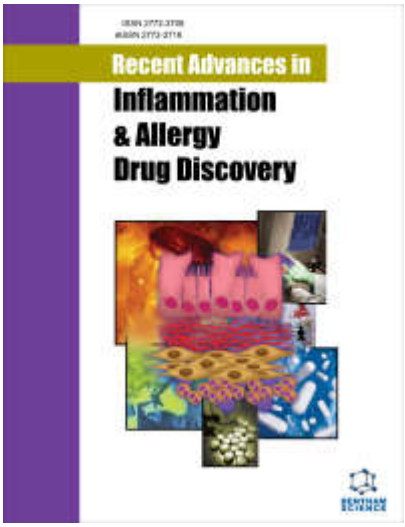

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Abstract | References | Citations | Supplementary Data

Background: Recently, researchers have worked on the development of new methods for the synthesis of bioactive heterocycles using polyethylene glycol as a green solvent. In this context, we report the synthesized 2-(2-hydrazinyl) thiazoles for their in vitro antioxidant, in vitro anti-inflammatory and in vitro anti-cancer activities.

Objective: The objective of the study was to develop novel antioxidant, anti-inflammatory and anti-cancer drugs.

Methods: At the outset, the condensation of substituted acetophenones 1, thiosemicarbazide 2, and α-haloketones 3 was carried out using PEG-400 (20 mL) in the presence of 5 mol% glacial acetic acid to afford thiosemicarbazones intermediate. Furthermore, these thiosemicarbazones were reacted with α-haloketones 3 to obtain appropriate 2-(2-hydrazinyl) thiazoles. The synthesized compounds were in vitro tested for their antioxidant, anti-inflammatory, and anti-cancer activity.

Room-temperature ammonia gas sensor based on carboxylic acid-doped polyaniline

Original Paper Published: 04 April 2022

Volume 80, pages 3183–3195, (2023) Cite this article

Polymer Bulletin

Aims and scope

Submit manuscript

Renukacharya G. Khanapure, Anil A. Ghanwat, Sharad K. Awate, Uttam S.Gawali, Rajesh J. Kavade, Pravin H. Salunkhe & Suresh V. Patil

Abstract

Polyaniline films modified by carboxylic acid dopents have been formed by in situ chemical oxidative polymerization using ammonium persulfate as an oxidizing agent and investigated for NH_3 gas sensor. We demonstrate that butyric acid-doped polyaniline (BPANI) film is highly selective to NH_3 with high selectivity (513% at 100 ppm), fast response time (8.94 s). Furthermore, good reproducibility was also observed at 100 ppm. The room-temperature functioning of the sensor is critical, which facilitate low-power operation and also enhances the life time of the sensor. The results indicate that the carboxylic acid-doped polyaniline films are promising for NH_3 gas detection.

ScienceDirect

Journal of Molecular Structure

Volume 1299, 5 March 2024, 137173

High-performance supercapacitive polyazomethines: Room temperature synthesis and their characterizations

Amburaya S. Birajdar [a], Shailesh G. Pawar [b], Anil A. Ghanwat [c], Vijaykumar P. Ubale [a]

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https://doi.org/10.1016/j.molstruc.2023.137173

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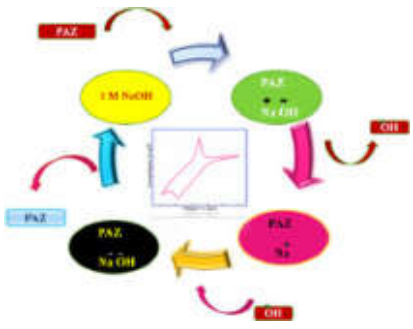
Abstract

A room temperature synthesized polyazomethine (PAZ) series via polycondensation route comprising monomer as 5-[4-(5-formylfuran-2-yl)phenyl]furan-2-carbaldehyde (III) and various diamines to engineer PAZ-1 to PAZ-5 polymers. Physico-chemical properties of as-prepared PAZ series have confirmed by X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), energy dispersive X-ray analysis (EDAX), transmission electron microscopy (TEM) and spectroscopic techniques. In FTIR, –CH=N– peak at 1600 cm^{-1} attributed to the successful conversion of dicarbaldehyde (III) and diamines into polyazomethine. The amorphous nature of PAZ series is depicted by XRD diffractograph. The marigold like morphology of polyazomethines has revealed in FESEM and TEM images. The chemical composition and elemental distribution on PAZ surface has mapped using EDAX technique. The electrochemical activity of as-prepared polyazomethine electrodes has investigated by cyclic voltammetry (CV), galvanostatic charge discharge (GCD) and electrochemical impedance spectroscopy (EIS) techniques. The supercapacitive performance of PAZ-1 to PAZ-5 electrodes in various electrolytes as NaOH, KOH, Na_2SO_4, and LiCl by varying concentrations, the PAZ-2 electrode exhibits elevated specific capacitance (C_p) of 831 Fg^{-1}, specific energy (SE) 22.99 $Whrkg^{-1}$, specific power (SP) 82.87 $KWkg^{-1}$ in optimum 1 M NaOH electrolyte. The distinguished PAZ-2 electrode after successive 500 cycles has delivered exceptional stability, 71.65% in 1 M NaOH.

Graphical Abstract



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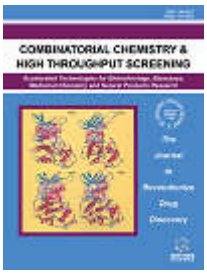

Synthesis of Novel Hydrazones of Levofloxacin Related Molecule and their In Vitro Evaluation as Antioxidant, and Molecular Docking Studies

Authors: Kashid, Bharat B.; Kilbile, Jaydeo T.; Wani, Kishor D.; Pawar, Suhas. M.; Khedkar, Vijay M.; Ghanwat, Anil A.
Source: Combinatorial Chemistry & High Throughput Screening, Volume 25, Number 2, 2022, pp. 274-283(10)
Publisher: Bentham Science Publishers
DOI: https://doi.org/10.2174/1386207323666201229150734

Abstract | References | Citations | Supplementary Data

Objective: The research work aims to synthesize novel series of hydrazones and antioxidant screening. It also aims to evaluate the binding affinities and in silico methods for identifying possible drug targets of synthesized compounds.

Methods: This report briefly explains the synthesis of a novel series of hydrazones. It was synthesized via. hydrazinolysis of esters to obtain hydrazide, treated with aldehyde and acetophenone to get hydrazones. The spectral confirmed hydrazones exhibited excellent to comparable anti-oxidant as compared to the standard drugs Butylated hydroxytoluene (BHT) and Ascorbic acid. Molecular docking on myeloperoxidase (MPO) demonstrated the ability of this scaffold to correctly recognize the target and engage in significant bonded and non-bonded interactions with key residues therein.

Results and Discussion: In this study, we report effectively synthesized compounds BK-35, BK- 41, BK-26, BK-28, and BK-39 that showed the best DPPH radical scavenging activity. The docking results clearly showed the binding mode of hydrazones into the active site of Myeloperoxidase (MPO). In in-silico results, none of the synthesized compounds, BK-24 to BK- 41, violated Lipinski's rule of five (miLog P ≤ 5).

Conclusions: In vitro preliminary anti-oxidant screening results in support by in Silico binding affinity data of novel hydrazones of levofloxacin related molecules BK-24 to BK-41 reported here have emerged as excellent anti-oxidant agents. The inference derived from the in vitro anti-oxidant screening data and the quantitative insights derived from the per-residue interaction analysis with MPO enzyme are now being fruitfully utilized for site-specific mutation around the nucleus to identify selective and potent anti-oxidants.

ScienceDirect

Journal of Trace Elements and Minerals

Volume 2, December 2022, 100026

Development of new efficient and cost effective liquid-liquid extractive determination method for cobalt(II): Analysis of water, alloys and nano powder

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https://doi.org/10.1016/j.jtemin.2022.100026

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Abstract

Background

The renowned biological role of cobalt is it is main component of vitamin B12, however other cobalt compounds have been listed as toxic for the environment as well as to human.

Methods

Various samples from different sources are analyzed for their cobalt(II) content by extraction followed by UV–visible spectrophotometry and compared with atomic absorption spectrophotometry.

Results

In this article, the chromogenic reagent 2-chlorobenzaldehyde thiocarbohydrazone is introduced for extractive spectrophotometric determination of cobalt(II) from various samples. This reagent forms yellow colored 1:2:2 [Co(II)–2CBTCH–iodide] complex in dichloromethane which was extracted from an acetate buffer having pH of 4.2 in presence of potassium iodide solution which was stable up to 48 h. The absorbance of the complex exhibit peak absorbance at 400 nm. The present technique was optimized for numerous influences and the interference of other ion has also been cautiously studied. The calculated values of molar absorptivity and Sandell's sensitivity of the complex are found to be 0.3006×10^4 mol^{-1} cm^{-1} and 0.0196 μg cm^{-2} respectively. The technique conforms Beer's law up to 13 μg mL^{-1} with 0.999 correlation coefficient of the [Co(II)–2CBTCH–iodide] complex, which specifies linearity between the two variables. For five replicate determinations (n=5), the relative standard deviation was 1.18 with the regression equations as y=0.0672 x+0.01 with R^2=0.999 as the correlation coefficient. The recovery percentages were warranted the accuracy and found around 99.0%.

Conclusion

In Vitro Anticancer Screening, Molecular Docking and Antimicrobial Studies of Triazole-Based Nickel(II) Metal Complexes

by

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Molecules **2022**, *27*(19), 6548; **https://doi.org/10.3390/molecules27196548 (https://doi.org/10.3390/molecules27196548)**

Submission received: 8 September 2022 / Revised: 27 September 2022 / Accepted: 29 September 2022 / Published: 3 October 2022

(This article belongs to the Special Issue **Chemistry of Nitrogen Heterocyclic Compounds (/journal/molecules/special_issues/nitrogen_heterocycl_compd)**)

ScienceDirect

Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy

Volume 285, 15 January 2023, 121918

Analytical optimization of liquid–liquid extractive spectrophotometric assessment protocol for tetravalent platinum: Analysis of environmental samples and cisplatin

Abdul B. Shaikh [a], Umesh B. Barache [a b], Anjana S. Lawand [b], Ganesh S. Kamble [c d], Muddsar L. Gaur [e], Shashikant H. Gaikwad [a]

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https://doi.org/10.1016/j.saa.2022.121918

Abstract

An easy and reliable method is optimized for extractive spectrophotometric assessment of platinum(IV) with 4-(4′-nitrobenzylideneimino)-3-methyl-5-mercapto-1,2,4-triazole as an extractant. The basis of this method is the formation of red platinum(IV) complex with the above reagent in acetate buffer medium (pH 5.0) and extraction in chloroform. Good linearity with regression equation as $y=1.011\times10^{4}\times+0.002$ having correlation coefficient (R^2) of 0.998 over concentration up to 17.5μgmL^{-1} of platinum(IV) was achieved with apparent molar absorptivity of 1.011×10^{4} L mol^{-1} cm^{-1}. The limit of detection (0.22μgmL^{-1}), limit of quantification (0.73μgmL^{-1}) and Sandell's sensitivity (0.0193μgcm^{-2}) were also estimated. The interference of various cations was removed by using proper masking agents and consequently by using EDTA and citrate to mask certain transition metals, the method becomes highly specific for platinum(IV), including the effects of platinum group metals. The method is effectively used for determination of platinum(IV) from environmental and real samples such as alloys, catalysts, thermocouple wire and pharmaceutical sample.

Graphical abstract

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Chemosphere

Volume 323, May 2023, 138067

Potential arsenic–chromium–lead Co-contamination in the hilly terrain of Arunachal Pradesh, north-eastern India: Genesis and health perspective

Ritusmita Goswami [a], Chandrashekhar Bhagat [b f], Igo Lollen [c], Nikita Neog [a], Umesh B. Barache [d], Ritu Thakur [e], Jurgen Mahlknecht [g], Manish Kumar [f g]

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https://doi.org/10.1016/j.chemosphere.2023.138067

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Abstract

In the recent times, multi-metal co-contamination in the groundwater of various parts of the globe has emerged as a challenging environmental health problems. While arsenic (As) has been reported with high fluoride and at times with uranium; and Cr & Pb are also found in aquifers under high anthropogenic impacts. The present work probably for the first time traces the As–Cr–Pb co-contamination in the pristine aquifers of a hilly terrain that are under relatively less stress from the anthropogenic activities. Based on the analyses of twenty-two (n=22) groundwater (GW) samples and six (n=6) sediment samples, it was found that Cr being leached from the natural sources as evident from 100% of samples with dissolve Cr exceeding the prescribed drinking water limit. Generic plots suggests rock-water interaction as the major hydrogeological processes with mixed Ca^{2+}-Na^{+}-HCO_3^{-} type water. Wide range of pH suggests localized human interferences, as well as indicative of both calcite and silicate weathering processes. In general water samples were found high only with Cr and Fe, however all sediment samples were found to contain As–Cr–Pb. This implies that the groundwater is under-risk of co-contamination of highly toxic trio of As–Cr–Pb. Multivariate analyses indicate that the changing pH as the causative factor for Cr leaching into the groundwater. This is a new finding for a pristine hilly aquifers, and we suspect such condition may also be present in other parts of globe, and thus precautionary investigations are needed to prevent this catastrophic situation to arise, and to alert the community in advance.

Graphical abstract

ScienceDirect

Colloids and Surfaces A: Physicochemical and Engineering Aspects

Volume 652, 5 November 2022, 129741

Fabrication of ternary polyvinyl alcohol/tetraethyl orthosilicate/silicotungstic acid hybrid membranes for pervaporation dehydration of alcohol

Mukund Mali [a f], Laxman Walekar [a], Dattakumar Mhamane [b], Gopal Mali [f], Samadhan Pawar [c], Vaishali Patil [d], Harichandra Parbat [c], Govisiddappa Gokavi [f]

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https://doi.org/10.1016/j.colsurfa.2022.129741

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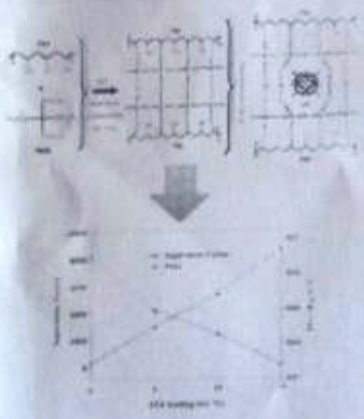
Abstract

Herein, we present simple method of fabrication and pervaporation application of organic/inorganic ternary nanocomposite membranes. These are obtained from novel combination of poly(vinyl alcohol)/tetraethyl orthosilicate (PVA/TEOS) along with incorporation of silicotungstic acid (STA) nanoparticles *via* solution casting method. Physico-chemical structure has been confirmed by using various characterization tools. Pervaporation efficiency of these new nanocomposite membranes in terms of flux and separation factor is investigated for one of the important processes of ethanol separation (azeotropic mixture separation) from its aqueous solution. Dramatically boosted pervaporation separation efficiency by PVA/TEOS membranes has been observed as a result of STA incorporation. The results are also confirmed by calculating diffusion coefficients and activation energies using Fick's and Arrhenius equations, respectively.

Graphical abstract



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ISSN 2277-7067
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ASPECTS OF INFORMATION DISSEMINATION IN INFORMATION SOCIETY FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT

We are now in the era of long-term development. While adapting a sustainable development strategy, we are looking for a variety of tools and strategies to help us achieve our aims. Information transmission that is effective is a tool for achieving long-term growth. It is the most effective way of reaching out to the general public. The purpose of this study is to assess the function of information distribution in the information society in terms of long-term growth. The necessities of knowledge transmission and important components for sustainable development are also explored in this research study. This research report is based on both primary and secondary evidence on the subject at hand. The dynamics of sustainable development are unique. Every word, such as economy, environment, and equity, has its own set of prerequisites. Information distribution is an important aspect of the process of sustainable development, and it may be done through a variety of means. People are also employing modern communication technologies to meet their wants in accordance with their changing circumstances. The actual sustainable development process necessitates proper information transmission. With examples, issues, tactics, and a strategy, this article presents essential information about information distribution and the information society.

Keywords: Information Society, Information Dissemination, Communication, Mass Media, Social Media, Media Literacy.

INTRODUCTION

Information repositories have radically modified their information distribution platforms and new methodologies as a result of improvements in communication technology. Libraries, websites, archives, social media platforms, and other information sources have become indispensable for meeting the requirements and desires of twenty-first-century users. Platforms for disseminating information have taken on new functions in recent years, using diverse technologies such as mobile technology and social media. Because of their potential to give high-speed and effective access, these new generation information services are becoming increasingly popular. Information communication systems provide a range of benefits to existing information searchers, including 24/7 connection, self-service platforms, limitless access, and time savings. The goal of this study is to explore various information dissemination tactics in the information society age. The purpose of this article is to educate and create awareness about the usage of new trends and approaches in the distribution of information. The information in this study is derived from secondary sources. It's a thorough desktop investigation.

UGC CARE LISTED
ISSN No.2394-5990

संशोधक

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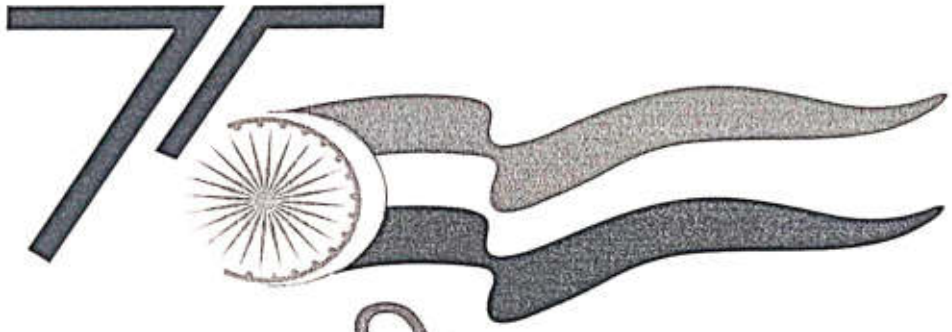

आज़ादी का अमृत महोत्सव

इतिहासाचार्य वि. का.राजवाडे संशोधन मंडळ, धुळे

ISSN No. 2394-5990

सोलापूर जिल्ह्यातील मोहरम सण व सांस्कृतिक समन्वय

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प्रस्तावना :

भारत भूमी ही विविध धर्मांची जन्मभूमी असून येथे अनेक धर्म, पंथ व उपपंथ निर्माण झाले. प्राचीन, मध्ययुगीन आणि आधुनिक संस्कृतीच्या जडण-घडणीमध्ये धर्माचा महत्त्वाचा वाटा आहे. म्हणूनच धर्म आणि संस्कृती असे समिकरण सर्वत्र पाहावयास मिळते. काळानुरूप मानवी जीवनात उदात्त स्वरूपाचा साक्षात्कार होतो. परंतु या धर्माचे स्वरूप इतिहास काळात वेळोवेळी बदलत गेले. महाराष्ट्राला विविध धर्म आणि धार्मिक स्थळांची फार मोठी देणगी मिळालेली दिसून येते. म्हणून धार्मिक स्थळे ही मानवी जीवनाचे अंग मानल्याने हा घटक समाजावर प्रत्यक्ष व अप्रत्यक्षपणे परिणाम करताना दिसून येतो. मध्ययुगीन काळात भक्तीची लाट संपूर्ण देशभर निर्माण झाली होती त्यातून महाराष्ट्रात अनेक भक्तीसंप्रदाय उदयाला आले. वारकरी, दत्त, नाथ, वीरशैव (लिंगायत) आणि सुफी इत्यादी संप्रदाय व भक्तीपंथांचा त्यात समावेश होतो.

सोलापूर परीसरात हिंदु, जैन, बौध्द, लिंगायत, मुस्लिम, ख्रिश्चन अशा विविध धर्म व पंथाचे लोक राहतात. अशा धर्माचा वा पंथाचा प्रभाव सोलापूरवर पडलेला दिसून येतो. तेराव्या शतकात भारतात सुफींचे आगमन झाले. त्यांनी भारताच्या विविध भागात आपल्या पंथाचा प्रसार व प्रचार करून लोकजागृती करण्याचा प्रयत्न केला. असे अनेक सुफी संत सोलापूर जिल्ह्यातही कार्यरत होते. त्यांनी याच भूमीत आपला देह ठेवला, त्यामुळे सोलापूर परिसरात अनेक सुफी संतांचे दर्गे पाहावयास मिळतात. अशा विविध धार्मिक स्थळांच्या अनुषंगाने दरवर्षी विविध देव-देवता व संताच्या यात्रा, उरूस व उत्सवाच्या निमित्ताने कर्नाटक आणि आंध्र प्रदेशातील अनेक भाविक सोलापूर परीसरात येतात त्यामुळे येथे विविध संस्कृतींचा संगम पहावयास मिळतो.

संशोधनाची उद्दिष्टे :

सोलापूर जिल्ह्यातील मोहरम सण व सांस्कृतिक समन्वय विषयाची माहिती समाज आणि वाचक यांच्यापुढे यावी हा प्रस्तुत संशोधनाचा उद्देश आहे. संशोधनाची उद्दिष्टे खालील प्रमाणे आहेत.

१) सोलापूर परीसरातील मुस्लिम धार्मिय स्थळ, सण व उत्सवाचा अभ्यास करणे.
२) सोलापूर परीसरातील मोहरम सणाचा इतिहास प्रकाशात आणणे.
३) सोलापूर परीसरातील मोहरम सणाच्या अनुषंगाने सांस्कृतिक व समन्वयवादी अनुबंध तपासणे.

संशोधन पध्दती:

या संशोधनात ऐतिहासिक व सर्वेक्षणात्मक संशोधन पध्दतीचा उपयोग केलेला असून प्राथमिक व दुय्यम संदर्भ साधने, अप्रकाशित साधने, अभिलेखागारातील उपलब्ध मूळ कागदपत्रे व संदर्भ ग्रंथ तसेच नकाशे, फोटो साधनांचा वापर या संशोधन लेखनासाठी केलेला असून धार्मिक स्थळांतील लोकांचा सहभाग समजून घेण्यासाठी शहरातील विविध देवस्थान समितीचे प्रमुख, इत्यादिंच्या मुलाखतीद्वारे माहिती गोळा केलेली आहे.

प्रस्तुत संकलित साधनांचे पुरातत्वीय स्थळांच्या अनुषंगाने वर्गीकरण करून या स्थळांच्या अनुषंगाने प्रस्तुत परीसरातील सांस्कृतिक सण, उत्सव, परंपरा यांच्या दृष्टीने वर्णनात्मक व विश्लेषणात्मक मांडणी केली आहे. प्राथमिक साधनांचे दुय्यम साधनांशी तौलनिक अभ्यास करून आवश्यक त्या ठिकाणी छायाचित्रांचा आणि नकाशाचा उपयोग करण्यात आला आहे. सदर तथ्यांच्या आधारे सोलापूर परीसरातील मुस्लिम धार्मिय स्थळे, सण, उत्सव व परंपरा यांचा इतिहास प्रकाशात आणण्यात आला.

सोलापूर शहराचे भौगोलिक स्थान :

भौगोलिकदृष्ट्या सोलापूर जिल्हा १७ओ १०ओ व १८ओ ३२ओ उत्तर अक्षांश आणि ७४ओ ४२ओ व ७६ओ१५ओ पूर्व रेखांशावर वसलेला आहे. सोलापूर शहर हे जिल्ह्याचे ठिकाण असून रेल्वे मार्गावरील महत्त्वाचे व्यापारी केंद्र आहे. मध्ययुगीन कालखंडात सोलापूर जिल्ह्याच्या सीमारेषा वेगवेगळ्या

UGC Care Group 1 Journal

ISSN : 2278-6864

EDUCATION AND SOCIETY

शिक्षण आणि समाज

Vol. 47, No.2 April-June 2023

INDIAN INSTITUTE OF EDUCATION
J.P. Naik Path, Kothrud, Pune-38

Education and Society शिक्षण आणि समाज
ISSN : 2278-6864

UGC Care Group 1 J

कुक्कुटपालन आणि ग्रामीण महिला सक्षमीकरण

प्रा. डॉ. जी.एस . कांबळे
संचालक, सामाजिक शास्त्रे संकुल
पु .अ .हो .सोलापूर विद्यापीठ सोलापूर

श्री समाधान शामराव भोरकडे
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गोषवारा -

भारत हा देश शेतीप्रधान देश आहे . देशातील निम्याहून अधिक जनता हि शेतीवर आधा व्यवसाय करते , शेती हि ग्रामीण भारताची जीवनवाहिनी आहे , मात्र फक्त शेती न क शेतीला पूरक असा जोडधंदा म्हणून कुक्कुटपालन केले जाते. खरेतर कुक्कुटपालन हा काही न व्यवसाय नाही देशामध्ये परंपरागत असणारा हा व्यवसाय आहे मात्र स्वातंत्र्यनंतर मात्र याम वराचसा वदल झाला आहे व सध्या हा व्यवसाय अनेक ग्रामीण महिलांच्या उदरनिर्वाहाचे सा वनला आहे. ग्रामीण भागातील महिलांना अतिशय कमी भांडवलामध्ये जास्त उत्पादन देण व्यवसाय म्हणून याकडे पहिले जात आहे. यातून महिलांचे आर्थिक व सामाजिक सक्षमीकर होत असल्याचे दिसत आहे.

प्रस्तावना -

भारत देश हा हा कृषिप्रधान देश आहे . देशातील ५० टक्के लोक हे शेतक आहेत . खरेतर शेतीप्रधान देशामध्ये सध्याच्या युगात फक्त शेती करणे म्हणजे तारेवरची कसर असल्यासारखे आहे . फक्त शेतीवरच अवलंबून राहिले तर ती शाश्वत उपजीविका होणार नाही त्यामुळे शेतीला जोडधंदा असण गरजेचे आहे . यामध्ये पशुपालन , कुक्कुटपालन, शेळीपालन यासारखे जोडधंदे जोडीला असन हे गरजेचे आहे . ग्रामीण भागामध्ये प्रामुख्याने केला जाणार व्यवसाय म्हणजे कुक्कुटपालन होय. कुक्कुटपालन शेतीवर आधारित कुटुंबाना आर्थिक बळ देणारा महत्वाचा व्यवसाय आहे . . ग्रामीण भागामध्ये अत्यंत उपयुक्त , किफायतशीर , हा व्यवसाय ठरलेलें आहे . ग्रामीण भागामध्ये प्रामुख्याने महिला हा व्यवसाय करतात , महिला

UGC Care Group 1 Journal ISSN : 2278-6864

EDUCATION AND SOCIETY

शिक्षण आणि समाज

Vol 47, No 2 April-June 2023

INDIAN INSTITUTE OF EDUCATION
J.P. Naik Path, Kothrud, Pune-38

Women Entrepreneurship and Financial Inclusion

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Abstract:

Women entrepreneurship and financial inclusion both are on the rise in the present time. Digitalization, India's collective and remarkable shift towards less cash economy, Jan Dhan, Aadhar and mobile that is JAM Trinity all have contributed significantly to the financial inclusion of women but what about women entrepreneurs? Where are they in the race? Have they caught up with the speed? Have the fruits of financial inclusion reached them? Let's do a little deeper to find it out.

Keywords: Financial Inclusion, Women Entrepreneurship, Initiatives, SHG

Introduction:

Women, from the time immemorial Had 'Stridhan' as the only financial resource. With the dawn of independence in India women got the most awaited fundamental, natural, and human rights. thanks to the provisions and rights enshrined in the constitution of India and subsequent legislations regarding the same. independent India enabled women to vote, get educated and get employed without any prejudices but at the same time a lot of work had to be done regarding women entrepreneurship it remained a distant dream. Financial Inclusion of women not being an exception to it.

The scenario improved gradually. Women In the field of public service, law medicine, teaching, sports, film industry Started showing up with better numbers. In post-independence era, women entrepreneurship was still not in vogue, consequentially no conscious state efforts regarding the same. also, in that period women were less educated there was no financial and family support for women therefore there was less financial inclusion of women. Financial inclusion remained restricted to wealthy and employed, that too in traditional terms

Since the economic liberalization in 1991, the government has come up with many policy initiatives to promote entrepreneurship and growth. State governments are doing work to support women entrepreneurship – to promote overall growth. In India, the Micro, Small & Medium Enterprises Development organizations, various State Small Industries Development Corporations, the nationalized banks and even NGOs are conducting various programs that target and include entrepreneurs. In addition to the special schemes for women entrepreneurs, various government schemes for MSMEs also provide certain special incentives and concessions for women entrepreneurs for instance,

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ISSN 2277-7067
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EVALUATION AND UNDERSTANDING OF WELFARE SCHEMES FOR BIDI WORKERS

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ABSTRACT

Bidi production employs primarily women and children. It's a long, arduous process. In terms of its ability to provide potential employment possibilities to a vast number of people, the bidi business holds a key position in rural development. Because each bidi is rolled separately, this is a time-consuming operation.

The bidi industry is on the verge of becoming a cottage industry. As a result of the UN organized sector, even government personnel are finding it difficult to execute the law. A number of legal obligations Apart from the legal ramifications, there are also a health risk to consider. The number of female employees rolling bidis is significant. The goal of this research paper is to evaluate and understand the welfare schemes of bidi workers.

Keywords: Bidi rollers, social security, Welfare measures

INTRODUCTION

Bidi rolling is typically performed by workers that have a lower socio economic level in society. The majority of bidi work is done in rural and quasi regions, a bidi is a thin Asian cigarette made of 0.2-0.3 g of tobacco flake wrapped in a tendu leaf and secured with colored thread at both ends. Women constitute a very high percentage of labour force in the industry. The reason for this is, firstly, the work is done generally from home and women can do it while at the same time attending to their children and other household chores; secondly, their deft fingers are more suited to the work of bidi rolling, besides, The workers, being sloppy, (unorganized) are by and large denied of numerous offices, for example, least wages, federal retirement aide and other work benefits .Prior the workers were not safeguarded by a particular work regulations. Nonetheless, in1976 a Demonstration, specifically, the Bidi and Stogie Laborers' (States of Work) Act was passed by the Parliament. The principle motivation behind this Act is to safeguard in the interest of bidi laborers.

OBJECTIVES

- To critically examine the social security and welfare schemes for bidi workers.
- To study the different welfare schemes of government providing the bidi workers
- To suggest the improvements to provide effective welfare schemes.

NEED OF WELFARE SCHEMES FOR BIDI WORKERS

The majority of bidi workers are either homeless or live in inadequate housing. Bidi workers get paid less or do not get paid at all if the contractors reject the entire batch of bidis. Unsanitary working conditions and frequent tobacco inhalation cause diseases such as cancer, tuberculosis, and eye issues; among others Continuous inhalation of bidi toxins is injurious to one's health and has been shown to affect the delivery of healthy children as well as miscarriages. Despite the fact that the government provides medical services,

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ISSN 2277-7067
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ROLE OF MGNREGA IN IMPROVING OF SOCIO-ECONOMIC STATUS OF RURAL LANDLESS AGRICULTURE LABOUR IN SOLAPUR DISTRICT

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ABSTRACT

Economic security is one of the main components of humanity in the globe. Economic security requires employment and an assured source of basic income adequate for meeting one's basic needs. Today the biggest challenges before the world are poverty, unemployment and pollution. The unemployment problems in developing countries, especially India sharply differs from that which prevails in developed nation. In India, the more serious problem is unemployment or disguised unemployment. The most important constituent of the unemployment in India are agriculture labour and most of them are from rural areas. So the government of India realized the need to empower the agriculture labour to ensure an impartial development of the country and has framed different programmes/schemes to uplift the landless labour from poverty and vulnerability of life by generating employment. One such landless labour friendly programme is Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), which aims at the development of rural areas. The present study attempts to assess the impact of the MGNREGA on landless agriculture labour in Solapur Rural District.

Keywords: Unemployment, MGNREGA, Employment.

INTRODUCTION

The implementation of MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act) has got tremendous potential to bring about far reaching improvements in the socio-economic life of the rural poor. The implementation of MGNREGA could be observed as a boon to unemployed rural landless agriculture labour in India, as it can enhance the socio-economic and political empowerment of rural people.

This in turn enhances the prospects of MGNREGA in Solapur, particularly with respect to rural people. In the above context, this paper looks into the salient features of the Act, its efficacy in empowering rural landless agriculture labour, along with its major problems and prospects; by making an empirical study at Solapur rural district in Maharashtra.

OBJECTIVES OF THE STUDY

- To study the salient features of MGNREGA in India.
- To analyse the potential of MGNREGA in bringing about socio-economic empowerment of rural Landless labour.

METHODOLOGY OF THE STUDY

The study is both descriptive and analytical. It is descriptive to the extent that it seeks to narrate the salient features of MGNREGA. The study is analytical too as it makes an analysis of the potential of

M.J. Patil *et al.*, *Man and Environment* XLVII(2): 51-63 [2022].

A Preliminary Report of Excavations at Ter (Tagar), District Osmanabad, Maharashtra (2014-2015)

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Abstract

Ter, ancient Tagar, is located on the banks of the River Terna in the Osmanabad District of Maharashtra. *Periplus of the Erythrean Sea* (c. 50-103 CE) makes the first literary reference to Ter. The site known as the 'ancient emporium', evidenced tremendous activity during the Indo-Roman trade. Since long, the site, has demonstrated its potential through various archaeological investigations. Owing to the fabulous significance of the site, an excavation was conducted in 2015, especially in the Bairagpandhar and Kot areas. The excavation was fruitful in various ways and produced substantial data on ancient Ter's chronology and trade linkages.

Introduction

Ter (76° 12' 30" N; 18° 19' 20" E) is one of the prominent and well-known archaeological sites situated on the banks of the River Terna, Osmanabad District, Maharashtra. The archaeological and historical importance of the site is well discussed by foreign travellers, archaeologists, and historians. Ter is associated with a renowned Marathi saint, Gora Kumbhar. The thick habitation deposit is spread over about 2.5 km (Fig. 1). Ter has been mentioned in the *Periplus of the Erythrean Sea* (c. 50-103 CE) as Tagar. In the 51st chapter, the anonymous author of this text describes Ter as an important trade centre of south India. He wrote, "... among the market towns of Dachinabades, there are two of special importance; Paethana, distance about twenty day's journey from Barygaza; beyond which about ten days journey east, there is another very great city, Tagara. There are brought down to Barygaza from these places by wagons and through great tracts without roads, from Paethana, carnelian in great quantity, and from Tagara much common cloth and other merchandise brought there locally from the region along the seacoast. And the whole course to the end of Damirica is seven thousand stadia; but the distance is greater to the coast country" (Schoff 1912). Ptolemy also mentions Tagar as being situated in the Ariake region, along with its latitude and longitude, in the book, *Geography*, written in the middle of the second century CE. Thus, the ancient texts mention that (1) Tagara was situated in Dakshinapath, (2) it was an extensive city, and (3) it was a great trading emporium.

A local Purana, 'Ter Mahatmya' composed in 1757 CE, states, "The town was called Satyapura in the Krutayuga, Shantpur in the Tretayuga, Kadkvati in the Dwaparyuga, and Siddhasram in the Kaliyuga". Pipilika river, Kalkunda, Nagvapi and Kukulykund were located in ancient Ter. Uttareshwarling and Bilweshwarling are also located in Ter. According to Fleet (1901: 537-552), 'Pipilika' is the ancient name of the River Terna (Deo 1986).

Due to its several mentions in foreign and Indian texts, archaeological research itself has a long history in Ter. The site was first inspected and explored by Henry Cousens at the beginning of the twentieth century (Cousens 1904: 195-204). During 1929-30, archaeologists from the Nizam's Archaeological Department inspected Ter. However, the first excavation of Ter was conducted only after India's independence in 1958 by Chapekar and Banerjee (Chapekar 1969). Owing to its importance and rapid destruction, Ter was again excavated by S.B. Deo and Pathi in 1975. The site was again excavated by the State Department of Archaeology and Museums, Government of Maharashtra in 1967-68, 1968-69, 1987, and 1988 (IAR 1968-69: 17-18, 1987-88: 87-88, 1988-89: 62-63). However, there are no detailed reports of these excavations. All this archaeological research at Ter did not provide a comprehensive picture of various aspects of the early historic society. Earlier excavations were small-scale and mainly focused on the antiquities, making them inadequate to provide details of this principal trade emporium of the

ceived : 02-04-2022
vised : 14-08-2022
cepted : 26-08-2022

ISSN - 2277-7067

पाण्डुलिताय नमः

Peer Reviewed

Journal of Fundamental & Comparative Research

Volume - IX, Issue 1 (I), 2022-2023

शोधसंहिता

SHODHSAMHITA
शोधसंहिता

ISSN 2277-7067
UGC CARE Group 1

APPLICATION OF INFORMATION COMMUNICATION TECHNOLOGY IN RURAL DEVELOPMENT AND CHALLENGES

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ABSTRACT

Information communication technology used by government and non-government organization for the rural development. In rural area people are less aware about the ICT. Some improvement and progression in the technologies provided by the government but there is no effect in the development of rural areas. Now days ICT are developing day by day but very less technology applicable in rural area. The rural development in India is the important factor for Indian economy. The present study focuses on poverty alleviation, better livelihood, and infrastructure facilities. Our nation still developing the public administration, rational principles etc. Application of ICT is playing a prominent role in strengthening the rural development. The ICT and Rural Development itself fill the gap between the educationally and technologically backward and forward sections of the society. The use of ICT application in rural development is immense at the same time government will also be facing some challenges.
Keywords: - ICT, Rural Development, Communication, Technology.

INTRODUCTION

India is a country of villages. In India 50% of the villages are very poor in Socio-Economic conditions. We have seen many problems of rural masses since the independence. The central governments five year plans also aim the Rural Development. In India we have the ministry of rural development is the apex body for formulating policies, regulations and act concerning to the development of the rural sector.

Agriculture, diary, poultry, fisheries, handicrafts are the primary contributors to the rural business and economy. Rural Development is concerned with economic growth and social justice. For the rural people development living standards, quality social services and basic needs become very essential. The present study focuses on poverty alleviation, better livelihood, and infrastructure facilities. Our nation still developing the public administration, rational principles etc. Application of ICT is playing a prominent role in strengthening the rural development. The ICT and Rural Development fill the gap between the educationally and technologically backward and forward sections of the society. ICT is the new tool for rural development ICT is the best tool for development at grass root levels. At the same time challenges also make them literate. There are various rural development schemes run by government of India.

NEED OF ICT IN RURAL CONNECTIVITY

ICT strengthen efforts towards implementation of rural development creativities through demand driven information and communication services. This ICT also strengthening the rural governance by improving transparency, accountability and administrative competence of rural institutions. Through this ICT we can improve the civil participation in rural governing development. The application of ICT has the power to improve living standards of people in remote as well as the rural area by providing the social, commercial and educational benefits. Information Technology Means the Communication way of Information. Information Technology is also connect the rural areas in this world of digitization. The rural

WORLD JOURNAL OF PHARMACY AND PHARMACEUTICAL SCIENCES
SJIF Impact Factor 7.632
Volume 11, Issue 9, 1461-1470 Research Article ISSN 2278 – 4357

EVALUATION ANTIBACTERIAL ACTIVITY AND GCMS ANALYSIS OF DATURA STRAMONIUM LEAF EXTRACT AGAINST BACTERIAL PATHOGENS

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Article Received on
14 July 2022,
Revised on 04 August 2022,
Accepted on 24 August 2022
DOI: 10.20959/wjpps20229-23164

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ABSTRACT

Medicinal plants are used for the treatment of microbial diseases due to their valuable effects in healthcare. Plant based drugs are indeed the first material used as an alternative medicine against many diseases. The objective of this study is to determine the phytochemical constituent and antibacterial activity of *Datura stramonium* leaf extract against bacterial pathogen causing nosocomial infection. The leaf extracts of *D. stramonium* were prepared by Continuous Soxhlet extraction method. Antibacterial activity of *D. stramonium* leaf extracts against *Staphylococcus aureus, Salmonella typhi, Escherichia coli, Pseudomonas aeruginosa* were studied by agar well diffusion method. Antibacterial activity was present in the methanol extract of *D.stramonium* showed maximum antibacterial activity against *Pseudomonas aeruginosa* followed by *Staphylococcus aureus*. Phytochemical analysis showed presence of alkaloids, tannins and arthraquinones in extract. GCMS analysis of *Datura stramonium* leaf extracts reveled presence of Dibutyl phthalate, Neophytadiene and Benzyl benzoate. Phytochemical compounds present in this plant extract responsible for antibacterial effect on bacterial pathogens. This biological active compound shows therapeutic uses, reliability and less toxicity to treat various infection caused by this bacterial pathogens. The *D.stramonium* leaf

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ISSN No. 2394-5990

Indian Government Thoughts and Policies for Ethanol Production and itsimpact on the Indian Economy

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Abstract :

This paper reviews the existing research Indian Government Thoughts and Policies for Ethanol Production and its Impact on the Indian Economy. The researcherhighlights ethanol production. The paper also shows the relationship between Economics developmentand Government policy. The paper used the only conceptual methodology. This paper finds of the world has made some progress toward achieving high levels of economic development; This paper is helpful to researchers, businessmen, etc.Finally, some areas for future research are suggested.

Keywords : Ethanol Production, Government policy.

Introduction :

Ethanol Blending Program (EBP) has been a priority of the Government, especially since 2014. The National Biofuels Policy of India in 2018 had set a target of 20% blending with gasoline by 2030. The ethanol production increased from 38 Cr liters in 2013-14 to 173 Cr. liters in 2019-20, a jump of 4.5X. Considering the strong performance, the Hon'ble Prime Minister of India set a new target of 20% blending by 2025-26, reducing the timeline for the target to be achieved, by 5 years.

The objective of the Study :

1. Study of the Govt. policy for ethanol production.
2. Impact of Govt. Policy and thought for ethanol production.
3. Challenges of ethanol production Govt. Policy.

Scope :

This research is related Indian Govt. Thought and policies only Ethanol production. Impacts impact of Indian economy. The researcher used only secondary data.

Data collection :

Only secondary database of research.

1. Website
2. Newspaper
3. Government Report.

History of Ethanol Production and Policy :

The Energy Information Agency (2005) describes the report of ethanol. Ethanol utilize was to power an engine in 1826, and in 1876, Nicolaus Otto, the inventor of the modern four-cycle internal burning engine, used ethanol to power an early engine. Ethanol also was used as a power fuel in the 1850s, but its use was curtailed when it was taxed as liquor to support the payment for the Civil War. Ethanol utilizes as a fuel constant after the tax was repealed, and fuelled Henry Ford's Model T in 1908. The first ethanol combined with gasoline for use as an octane booster occurred in the 1920s and 1930s and was in high demand during World War II because of the fuel minimum.

Today's ethanol industry started in the 1970s when petroleum-based fuel became costly and environmental concerns involving leaded gasoline created a need for an octane. Corn

ISSN No. 2394-5990

A study of recent trends in rural marketing in India

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Abstract :

In India, 70% of the population lives in rural areas. We can no longer ignore India's rural areas. Rural areas are critical markets for businesses. Any business can now sell its product in rural areas using online marketing. As a result, industries must priorities the rural market.

Marketers are currently faced with the extremely difficult and challenging task of catering to the rural sector, which is now nearly impossible to ignore due to its rising income population growth rate and government emphasis on primary sector growth in the current five-year plan. The paper discusses current trends and challenges in rural marketing.

Key words : Rural Consumers and challenges, Rural Marketing, Rural Market.

Introduction :

India is one of the world's most populous countries. India's pandemic has been sustained due to the rural market. Because the majority of people live in rural areas, the rural market is of particular interest to many researchers, economists, and business owners. Because of technological advancements, any company can now promote and sell products in rural markets. Rural marketing must be prioritized by industries. Many strategies must be implemented to achieve this goal. An Indian company must enter the rural market.

Objective of study :

1) To understand the concept of rural Marketing
2) To study the need of rural Marketing in India.
3) To study recent trends in rural Marketing.
4) To study challenges before rural marketing.

Research Methodology :

The current study relies on secondary data gathered from books, journals, news articles, and government reports.

Review of Literature :

Ms. Lovely, Research scholar "A study of recent trends and innovation in rural Marketing" This study concentrated on current trends and innovation. This study concentrated on many facets of the rural market.

V.V. Devi Prasad "Prospects and problems of Indian Rural Markets –

This study concentrated on rural marketing issues. This study concentrated on several marketing strategies for reaching the rural market.

Bhavika Pandita Hakhroo. "Review of Rural Marketing in India and Innovation in rural marketing the goal of this study is to examine the current state of rural marketing in India. This research focused on innovations and strategies, as well as understanding the rural consumer in India.

North Asian International Research Journal of Business Economics & Management

ISSN: 2277-1018 Vol. 6, Issue-7 July-2022

IRJIF I.F. : 4.201

Index Copernicus Value: 56.02

Thomson Reuters ID: S-8304-2016

NAIRJC

A Peer Reviewed Refereed Journal

DOI: 10.6947/2277-1018.2022.00006.58

EMPIRICAL ANALYSIS OF HEALTH STATUS OF WESTERN MAHARASHTRA

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ABSTRACT

Present research paper studies the effects of health facilities in the research area. A field study has been done to see whether the existing modern health facilities in the area have a positive impact on the traditional health problems of the society like Infant Mortality, Maternal Mortality and Feticide. Preliminary data have been used for this research article. The formulated hypothesis in the paper is checked with the help of the Z-test. The research found that modern health care facilities have reduced the number of infant deaths and maternal deaths in society. On the other hand, the number of abortions using the same modern equipment has increased in urban as well as rural Maharashtra.

KEYWORDS *- Infant Mortality, Maternal Mortality, Feticide, Health Status and Western Maharashtra*

INTRODUCTION

The holistic development of any country depends on the economic, social, cultural and environmental development of that country. No one can deny the contribution of the social sector to development along with other sectors. The social sector mainly consists of education, health, arts, sports and hygiene (Bang, A., Reddy, M. H etc., 2002). Only when these factors are developed can a conducive environment be created for the development of the country. Therefore, the development of these elements is considered to be the first duty of every country and state. In this comparative type of research paper, the researcher compares the benefits of healthcare facilities in Maharashtra to the families of different social classes such as SC. ST. OBC and General.

North Asian International Research Journal of Social Science & Humanities

ISSN: 2454-9827 Vol. 8, Issue-7 July -2022

IRJIF I.F. : 3.015

Index Copernicus Value: 57.07 Indian Citation Index Thomson Reuters ID: S-8304-2016

NAIRJC

A Peer Reviewed Refereed Journal

DOI: 10.5947/2454-9827/nairjc/00009.43

HEALTH INFRASTRUCTURE DEVELOPMENT IN RURAL MAHARASHTRA

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ABSTRACT

This research paper makes a detailed study of the availability of healthcare facilities in rural Maharashtra. This has been studied, are the government health services available in rural Maharashtra adequate? During the study, it was noticed that the number of government hospitals and beds available in Maharashtra is far less than the demand of the population. But through the National Rural Health Mission, it was observed that primary health centres were set up in every village. This has made health services available to rural people on time and at reasonable rates. The modern and populous Maharashtra needs a large number of hospitals and beds not only in rural but in urban areas also.

KEY-WORDS- Rural Health, Health Infrastructure, PHCs, CHCs, and Health Expenditure

INTRODUCTION

Health and Medical facilities are very much important social services (Bhate-Deosthal, P., Khatri, R., etc., 2011. p.24). It is, therefore, is considered as one of the important sub-sectors of the social sector. It is expected that the government should play a very important role in the development of health and medical facilities. The role the government of Maharashtra has been playing by incurring its public expenditure have discussed in the article. Here it is time to examine the physical quantity of the health in the Rural Maharashtra. This article highlights different parameters and indicators of public health such as government expenditure on health, Public healthcare services like sub-centres, community health centres, primary health centres, availability of beds etc.,

PUBLIC HEALTH

Public health is generally defined as the science that guarantees safety and improves people and communities' health by preventing disease and injury and the science that uses strategic strategies and research (Bihari, B. D.,

SUCCESS STORY OF DAIRY FARMING PRACTICES AT KOLHAPUR DISTRICT: A CASE STUDY

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Gokul dairy collects milk from the rural part of the Kolhapur District. Among the various villages, Vadakshivale village is the major milk contributor to Gokul Dairy. Many families in the villages depend on the milk business. Dairy farmers are ahead in milk production and are undertaking many innovative practices to increase milk productivity. Therefore, the present study portrays the dairy farming practices in this village. The study has taken 100 dairy farmers to gather information about dairy farming practices. The unique features of the dairy farming practices in this village are; Dairy farmers prefer to accommodate both buffalo and cow in their cattle shed. Cattle sheds are equipped with many modern facilities, like rubber mats, lights, music systems, fans, foggers and flooring, etc., to enhance milk production. Dairy farmers are very prompt about cleaning the cattle shed and also particular about milking time. The animal's fodder consists of both green and dry fodder, but the proportion of the green fodder is more to get more milk quantity. Fodder is provided in chopped form along with some nutrients.

Keywords: *Dairy Farming, Practices, Village, Success Story*

1. INTRODUCTION:

Dairy farming is one of the important livelihood sources for rural people, and it offers different opportunities to rural and semi-urban people, such as increased farm income, additional employment or subsidiary occupation etc. Dairy farming provides an alternative and attractive means of development for small and marginal farmers and landless labourers. However, Maharashtra is distinct in the field of dairy development and particularly in the development of dairy cooperatives. Maharashtra is leading in milk production, but milk production is not uniform in all regions of Maharashtra. Western Maharashtra contributes significantly to milk production, and Kolhapur District is ahead in the western Maharashtra. Many cooperative unions are functioning, but Kolhapur Zilla Sahakari Dudh Utpadak Sangh Ltd. was much more popular in Maharashtra. It's popularly known as

Estimation of the Change Point in the Mean Control Chart for Autocorrelated Processes

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Abstract

Control charts are the most popular monitoring tools used to monitor changes in a process and distinguish between assignable and chance causes of variations. The time that a control chart gives an out-of-control signal is not the real time of change. The actual time of change is called the change point. Knowing the real time of change will help and simplify finding the assignable causes of the signal which may be the result of the shift in the process parameters. In this paper, we propose a maximum likelihood estimator of the process change point when a Shewhart $\bar{X}$ chart with autocorrelated observations signals a change in the process mean. The performance of the proposed change point estimator when used with $\bar{X}$ chart with AR(1) process is investigated using simulation study. The results show that the performance of the proposed estimator has good properties in the aspect of expected length and coverage probability. We illustrate the use of proposed change point estimator through an example.

Keywords: Change point; maximum likelihood estimator; control chart; average run length; autocorrelation; autoregressive process.

1. Introduction

Control chart is an important statistical process tool used to improve the quality of the manufacturing process which is widely used to monitor the process by distinguishing the assignable and chance causes of variations. It also helps us to detect changes in a process with issuing an out-of-control signal. Once control chart gives an out-of-control signal, that is, the assignable cause is present in the process, it is necessary to process practitioner that to identify and remove the sources responsible for the special cause of variability.

For the purpose of process improvement, process practitioner can take corrective action to return the process in the state of statistical control. The time at which the control chart gives an out-of-control signal, is not the real time of change and it shows the change with delay which depends on the size of the shift in process parameter. The actual time of change in the process is called change point. Finding the actual change point has been in great importance for many industries. The change point estimator when used with a control chart monitoring scheme helps

Statistics and Applications {ISSN 2454-7395 (online)}
Volume 20, No. 2, 2022 (New Series), pp 27-40

Identifying the Time of a Permanent Shift in the Normal Process Mean with Memory Type Control Chart

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Received: 20 March 2021; Revised: 03 June 2021; Accepted: 09 June 2021

Abstract

Control chart is a valuable statistical process control (SPC) tool used for monitoring the process performance. When control chart gives the out-of-control signal, the search initiates to identify the sources responsible for the special cause of variation. But control chart does not give the exact time when the process change begun. The time when the process change appears first in the process called change point. Knowing the change point in the process helps to identify the special cause of variation. This article discusses the approach based on the maximum likelihood estimator of process change to identify the time of a permanent shift in the normal mean with EWMA and MA control charts.

Key words: Statistical quality control; Change point; maximum Likelihood; EWMA control chart; Moving average control chart; Average run length.

1. Introduction

Control charts distinguish between the special cause of variation and the common cause of the variation in the process. To improve and control the process control charts are widely used in the manufacturing industries. Once control chart issues a signal that the special cause is present in the process. Process professionals should initiate a search for the special cause of the variation which could be quite difficult. The search depends on the professional's knowledge and experience. To quality improvement it is necessary to bring the process back into the statistical control. One essential step would help to quality improvement is that knowing the starting time the special cause of variation appears first in the process. Once it is possible to identify the exact time when the process happens due to special cause of variation appears first in the process, there may not be delay finding the occurrence of the special cause of the variation in the process. As a result, the special cause of variation can be identified more quickly, and the corrective action can be taken to eliminate the sources of the special cause of variation which leads to process improvement.

In recent years change point estimation in control charts has received a great deal of attention, as the change point estimation procedure simplify the effort to search for and identify special causes in statistical process monitoring. Hinkley (1970) considered inference about the point in a sequence of random variables at which the probability distribution changes. They compared asymptotic distribution of the MLE and likelihood ratio statistic with some finite sample distributions. Samuel *et al.* (1998a) proposed a method of maximum likelihood estimator to identify the time of step change in the normal mean with $\overline{X}$ control chart. Samuel *et al.* (1998b) considered the step change in the normal process variance.

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International Journal of Statistics and Reliability Engineering
Vol. 9(3), pp. 500-506, 2022 (ISSN(P): 2350-0174 ; ISSN(O):2456-2378)

IARS

ORIGINAL ARTICLE

The GLR Control Chart for the Maxwell Distribution

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Received: 01 October 2022 / Revised: 01 December 2022/ Accepted: 16 December 2022

Abstract

This paper proposes the generalized likelihood ratio (GLR) control chart for monitoring the scale parameter of the Maxwell distribution. A simulation approach is used to evaluate the performance of proposed chart in terms of the average number of samples to signal (ANSS).The performance of the proposed GLR chart is compared with the Shewhart and CUSUM charts. Simulation results show that the GLR control chart perform better than the Shewhart and CUSUM charts in detecting a wide range of parameter shifts in the Maxwell distributed process. A numerical example based on real data set is provided to illustrate the application of the proposed control chart.

Keywords: Control Chart; Average Number of Samples to Signal; Moving Window; Statistical Process Control

1. Introduction

A control chart is an online statistical process control (SPC) technique. It is widely used in many fields to monitor various processes such as industry, healthcare, education, business, social media, etc. Statistical process control (SPC) tools such as control charts are generally used to monitor a shift in process parameters. In SPC, it is usually necessary to monitor both the process mean and the process variability. The traditional Shewhart $\bar{X}$ chart is used to monitor process mean and R or S chart is used to monitor process variability. These Shewhart type charts are effective for detecting large shifts but are not effective for detecting small or moderate shifts in the process parameters. Exponentially weighted moving average (EWMA) and cumulative sum (CUSUM) charts can be used as an alternative to Shewhart type charts for detecting small to moderate shifts in the process parameters. A control chart that works reasonably well for a wide range of possible shifts is more useful in many practical applications. One approach to construct control charts that can detect small and large shifts in process parameters is to base the control charts on likelihood ratio tests. Such charts are usually called generalized likelihood ratio (GLR) charts.

In the existing SPC literature, GLR control charts have been developed to monitor processes with continuous data as well as count data. Most of the GLR charts are based on assumption that process output is normally distributed. Siegmund and Venkatraman (1995) were the first to propose a GLR chart for sequential detection of change-point in the mean of a normal process. Capizzi (2001) developed a design of change detection algorithms based on the GLR chart. Lai (2001) suggested the application for monitoring the mean of a normally distributed process with known variance. Reynolds and Lou (2010) proposed the GLR chart for monitoring the process mean of a normal process. It was shown that the GLR chart is effective for detecting wide range of shifts in the process mean. Reynolds et al. (2013) proposed the GLR chart for monitoring the mean and variance of a normally distributed process. It was shown that the GLR chart is effective for detecting a wide range of shifts in μ and σ^2. Peng and Reynolds (2014) studied the GLR control chart based on sequential sampling (SS GLR) to monitor the mean μ of a normal process. It was shown that The SS GLR chart has better performance than the fixed sampling rate GLR chart. In the existing literature, various GLR control charts have been proposed to monitoring count processes. Li (2012) proposed a GLR chart for Poisson distributed process with individual observations and compared it with EWMA and GWMA charts. Huang et al. (2012) proposed a binomial GLR chart for detecting increases in the process proportion p. Huang et al. (2013) also proposed a GLR chart for monitoring the proportion of nonconforming items when a continuous stream of Bernoulli observation is available. Lee and Park (2014) proposed a Poisson GLR chart to monitor a Poisson process. Lee et al. (2017) proposed the multinomial GLR chart to monitor a multinomial process. Kazemi Nia et al. (2018) developed a GLR chart for monitoring the parameter of a geometrically distributed process. They compared the performance of the GLR chart with the CUSUM and two combinations of CUSUM charts. It was shown that the GLR control chart outperforms these charts in detecting a wide range of parameter shifts in the geometrically

A NONPARAMETRIC CONTROL CHART FOR JOINT MONITORING OF LOCATION AND SCALE

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Abstract

Traditional control charts are based on the assumption that the process observations are normally distributed. However, in many applications, there is insufficient information to justify this assumption. Thus, nonparametric control charts have been designed in literature to monitor location parameter and scale parameter of a process. In this paper, a single nonparametric control chart based on modified Lepage test is proposed for simultaneously monitoring of location and scale parameters of any continuous process distribution. The charting statistic combines two nonparametric test statistics namely Baumgartner test for location and Ansari-Bradely test for scale. The performance of the proposed chart is examined through simulation studies in terms of the mean, the standard deviation, the median and some percentiles of the run length distribution. The average run length (ARL) performance of the proposed chart is compared with that of the existing nonparametric Shewhart-Cucconi (SC) and Shewhart-Lepage (SL) charts for joint monitoring of location and scale.

Keywords: Control chart; average run length; joint monitoring; nonparametric tests; location parameter; scale parameter.

1. Introduction

Control charts are the most important statistical process control tool used to monitor manufacturing processes with the objective of detecting any change in process parameters that may affect the quality of the output. Shewhart $\bar{X}$ and Ror S control charts are most popular control charts for monitoring process mean and process variability. These control charts are easy to implement but are based on the fundamental assumption that the distribution of quality characteristic is normal. In real applications, there are many situations in which process data come from non-normal distribution. In such situations, it is desirable to use nonparametric control charts. The main advantage of nonparametric control chart is that it does not assume any probability distribution for the characteristic of interest. A formal definition of nonparametric or distribution-free control chart is given in terms of its run-length distribution. The number of samples that need to be collected before the first out-of-signal is given by a chart is a random variable called the run-length; the probability distribution of the run-length is referred to as run-length distribution. If the in-control run-length distribution is same for every continuous distribution then the chart is called as distribution-free or nonparametric (Chakraborti and Eryilmaz [1]). The location and scale of a process are the two main parameters most often monitored in nonparametric control charts. The problem of monitoring the location of a process is important in many applications. The location parameter could be the mean or the median or some

Int. J. Agricult. Stat. Sci. Vol. 19, No. 1, pp. 1-7, 2023
DOI: https://doi.org/10.59467/IJASS.2023.19.1
www.connectjournals.com/ijass
ISSN : 0973-1903, e-ISSN : 0976-3392
ORIGINAL ARTICLE

NEW SAMPLING STRATEGY FOR ESTIMATING CAPABILITY INDICES FOR AUTOCORRELATED DATA

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Abstract: Process capability index is an important measure to evaluate the capability of the manufacturing process. Many of the process capability indices available in the literature are based on assumption of independence and normality of the process output characteristic. Shore (1997) among others has reported that ignoring the autocorrelation in the process characteristics can lead to wrong decisions. In this paper, the effect of the autocorrelation on commonly used capability indices C_p and C_{pk} is discussed. The first-order autoregressive process AR(1) is considered to model the data from an autocorrelated process. To reduce the effect of autocorrelation on these indices, the skip and mixed sampling techniques are implemented to form rational subgroups in the design of these indices. Results based on simulation study confirm that both the techniques improve estimates of capability indices significantly.

Key words: Process capability index, Autocorrelation, Skip sampling, Mixed sampling, First order autoregressive process.

Cite this article

M.M. Deshpande and V.B. Ghute (2023). New Sampling Strategy for Estimating Capability Indices for Autocorrelated Data. *International Journal of Agricultural and Statistical Sciences.* DOI: https://doi.org/10.59467/IJASS.2023.19.1

1. Introduction

Process capability analysis is an important SPC tool widely used to evaluate process performance after process is announced under statistical control. Traditionally, process capability indices are used to quantify the process performance in meeting the required specification limits. These are powerful tools of monitoring the process ability for manufacturing a product to meet the particular specifications. They provide quick indication of process capability with single number summary describing how a production process is capable of producing items meeting its specifications. The results of capability assessments are often used to set production strategies and guidelines to provide evidence of process performance and as validation for the customer [Montgomery (2001)]. Process capability indices have received much attention in the statistical literature during the recent years. Many researchers including Kane (1986), Chan *et al.* (1988), Boyles (1991), Pearn *et al.* (1992), Chen and Chen (2004) have contributed to the development of process capability indices.

Traditionally, the process capability indices are developed under the assumption that the process output data are independent and follow normal distribution. However, most of the processes in the real world produce autocorrelated data. For instance, the quality characteristics of many manufacturing processes in chemical, pharmaceutical and electronic industries often exhibit the property of autocorrelation. It is known that the autocorrelation affects the control chart performance as well as the values of capability indices built under independence assumption. The autocorrelated process, if unrecognized as an independent process, can lead to erroneous decision-making and quality loss. Hence the capability indices based on the assumption of independence are not valid when autocorrelation is present. The effect of autocorrelation on the amount of capability indices has

**Author for correspondence* *Received* February 17, 2022 *Revised* January 28, 2023 *Accepted* March 20, 2023

International Journal of Statistics and Reliability Engineering
Vol. 10(1), pp. 114-127, 2023 (ISSN(P): 2350-0174 ; ISSN(O):2456-2378)

IARS

ORIGINAL ARTICLE

Comparison of Bootstrap Confidence Interval Methods for Process Capability Indices C_p & C_{pk}

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Received: 29 August 2022 / Revised: 05 April 2023 / Accepted: 18 April 2023

Abstract

In this paper, some bootstrap confidence interval methods, namely standard bootstrap (SB), percentile bootstrap (PB), percentile t–bootstrap (PTB), bias corrected percentile bootstrap (BCPB), bias corrected and accelerated bootstrap (BCa) are considered for obtaining confidence intervals of commonly used process capability indices C_p and C_{pk} under normal and non-normal process distributions. The performance of these approaches for the capability indices C_p and C_{pk} is compared in terms of coverage probability and expected length using simulation. The results of simulation showed that among these confidence intervals the coverage probability and expected length of bias corrected percentile bootstrap (BCPB) approach is best.

Keywords: Average Width; Coverage Probability; Monte Carlo Simulation; Re-sampling.

1. Introduction

Statistical process control (SPC) tool involves online and offline monitoring of process such as control charts, process capability analysis, sampling inspection plans etc. The Shewhart type control chart is a traditional control chart which is used for monitoring the process as an in-control or out of control. In-control process does not suffice the precision about capability to meet customer requirements. Therefore, the capability analysis was developed to find the capability of the process to meet customer requirements. Process capability indices are used to determine whether a production process is capable of manufacturing items according to given specifications. They are formulated to quantify the relation between the pre-assigned specifications and the actual performance of the process. Extensive use of process capability indices in industry made it necessary to focus on point estimation and construction of confidence intervals for capability indices. Confidence interval estimation is an important part of process capability indices because it is an estimated value and provides much more information about population characteristic of interest than does a point estimate (Saha et al. (2018)). Initially, confidence intervals were constructed for normally distributed process. Later on these estimation techniques are also developed for non-normal distributed process.

In addition to above study Nagata and Nagahata (1994), Wang and Lam (1996) and Luceno (1996) studied the lower confidence limits, approximate confidence intervals for the process capability indices. Parchami and Mashinchi (2011) studied the application of interval estimation of an extended capability index in educational system. Recently, Somkhuean and Wongkhao (2022) have obtained generalized confidence interval (GCI), large sample (LS) and adjusted method of variance estimates recovery (adjusted MOVER) confidence intervals for C_p. The more discussion and references can be obtained from a review paper by Kotz and Johnson (2002). In many processes it is identified that the assumptions of normality are not followed by the process characteristic. In such cases an alternative procedure for finding the confidence interval for PCIs has to be provided. Niwitpong and Kirdwichai (2008) derived a new confidence interval for C_p based on an adjusted confidence interval for the standard deviation for non-normal data. Panichkitkosolkul (2016) proposed three CIs adjusted degrees of freedom (ADJ), Large-sample (LS) and augmented-large sample (ALS) for C_p.

Bootstrap confidence interval is one of the most useful and easy to interpret method for obtaining confidence interval. Efron (1979) have introduced and developed the nonparametric but computer-intensive estimation method called the bootstrap. In the development of confidence intervals, Efron and Tibshirani (1986) developed three types of bootstrap confidence intervals namely; the standard bootstrap confidence interval (SB), the percentile bootstrap confidence interval (PB) and bias corrected percentile bootstrap confidence interval (BCPB). Efron (1987) suggested that BCPB should be revised as the bias-correct and accelerated (BCa) bootstrap confidence interval. Franklin and Wasserman (1991) applied three bootstrap confidence intervals SB, PB and BCPB for the process capability index C_{pk} for normal and highly skewed processes. Tong and Chen (1998) derived the procedure to construct lower confidence limits of the PCIs using bootstrap simulation method, where estimators of PCIs for non-normal distribution obtained using order statistics. Han et al. (2000) constructed six bootstrap confidence limits for Wright' C_s and provided the simulation results under normal and lognormal distributions. Balamurali and Kalyanasundaram (2002) constructed the lower confidence limits for process capability indices C_p, C_{pk} and C_{pm}. They also provided the simulation results under normal, lognormal and chi-square distributions. Jian-feng (2007) discussed percentile-t bootstrap (PTB) method to estimate lower

RT&A, No 2 (73)
Volume 18, June 2023

A NEW CONTROL CHART FOR PROCESS DISPERSION BASED ON RANKED SET SAMPLING

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Abstract

In this paper, we propose a new control chart based on Downton's estimator (D) for monitoring the process dispersion using ranked set sampling design and runs rules. The performance of the proposed control chart is compared with the originally proposed D chart based on simple random sampling method when underlying process distribution is normal and non-normal. The average run length is used to evaluate the performance of the proposed control chart. It is observed that the proposed control chart is efficient in detecting shifts in process dispersion as compared with the chart using simple random sampling method. The performance of the proposed chart is further investigated using runs rules. The efficiency of the designed runs rules RSS-D chart is compared with its existing counterparts and is found to be superior.

Keywords: Control chart, Average run length, Process dispersion, Ranked set sampling, Runs rules, Downton estimator.

1. Introduction

In statistical process control (SPC), control charts are the most popular tools used to monitor the quality characteristics in an industrial process. Shewhart R chart and S chart are the commonly used control charts for monitoring the process dispersion. The R chart is based on the sample range (R) whereas S chart is based on sample standard deviation (S). These charts are based on subgroups of sample size n using simple random sampling (SRS) method. Both R and S charts are easy to implement and are effective in the detection of large shifts, but are less sensitive in the detection of small and moderate shifts in the process dispersion (Montgomery[1]).Several alternatives have been proposed in the literature to improve the performance of Shewhart type control charts. One recent approach is the construction of control charts based on ranked set sampling (RSS) scheme. The RSS scheme was first suggested by McIntyre [2]. This scheme ensures increased precision through ranking of observations. He pointed out that this sampling scheme works superior to standard simple random sampling (SRS) for estimation of the population mean. Takahasi and Wakimoto [3] laid the necessary mathematical formulation for this sampling scheme. Several researchers have studied applications of ranked set sampling in different streams. Kvam and Samaniego [4] showed that ranked set sampling may occur naturally in survival analysis. Kvam and Samaniego [5] studied the applications of this sampling scheme in reliability. Recently, RSS scheme has got considerable attention in the construction of control charts. Salazar and Sinha [6] first suggested control charts for monitoring process mean using RSS scheme. It was shown that the RSS based control charts perform better than the charts based on SRS. Muttlak and Al-Sabah [7]

A NONPARAMETRIC CONTROL CHART FOR JOINT MONITORING OF LOCATION AND SCALE

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Abstract

Traditional control charts are based on the assumption that the process observations are normally distributed. However, in many applications, there is insufficient information to justify this assumption. Thus, nonparametric control charts have been designed in literature to monitor location parameter and scale parameter of a process. In this paper, a single nonparametric control chart based on modified Lepage test is proposed for simultaneously monitoring of location and scale parameters of any continuous process distribution. The charting statistic combines two nonparametric test statistics namely Baumgartner test for location and Ansari-Bradely test for scale. The performance of the proposed chart is examined through simulation studies in terms of the mean, the standard deviation, the median and some percentiles of the run length distribution. The average run length (ARL) performance of the proposed chart is compared with that of the existing nonparametric Shewhart-Cucconi (SC) and Shewhart-Lepage (SL) charts for joint monitoring of location and scale.

Keywords: Control chart; average run length; joint monitoring; nonparametric tests; location parameter; scale parameter.

1. Introduction

Control charts are the most important statistical process control tool used to monitor manufacturing processes with the objective of detecting any change in process parameters that may affect the quality of the output. Shewhart $\bar{X}$ and Ror S control charts are most popular control charts for monitoring process mean and process variability. These control charts are easy to implement but are based on the fundamental assumption that the distribution of quality characteristic is normal. In real applications, there are many situations in which process data come from non-normal distribution. In such situations, it is desirable to use nonparametric control charts. The main advantage of nonparametric control chart is that it does not assume any probability distribution for the characteristic of interest. A formal definition of nonparametric or distribution-free control chart is given in terms of its run-length distribution. The number of samples that need to be collected before the first out-of-signal is given by a chart is a random variable called the run-length; the probability distribution of the run-length is referred to as run-length distribution. If the in-control run-length distribution is same for every continuous distribution then the chart is called as distribution-free or nonparametric (Chakraborti and Eryilmaz [1]). The location and scale of a process are the two main parameters most often monitored in nonparametric control charts. The problem of monitoring the location of a process is important in many applications. The location parameter could be the mean or the median or some

percentiles of the distribution. Many authors have developed nonparametric control charts to monitor location parameter of the process some of these includes Bakir [2-3], Chakraborti and Eryilmaz [1], Khilare and Shirke [4], Human et al. [5]. These charts are based on sign and/or rank statistics. Chakraborti et al. [6] and Chakraborti and Graham [7] presented an extensive overview of literature on nonparametric control charts and discussed their advantages.

The problem of monitoring the scale parameter of a process is also important in many applications. For monitoring scale parametric of a process very few nonparametric are available in literature. Amin et al. [8] proposed a sign chart for process variation based on quartiles. Das [9] proposed a nonparametric control chart for controlling variability based on squared rank test. Das [10] developed a nonparametric control chart based on rank test. Das and Bhattacharya [11] proposed a control chart for controlling variability based on some nonparametric tests. Murakami and Matsuki [12] developed a nonparametric control chart based on Mood statistic for dispersion. Khilare and Shirke [13] developed a nonparametric synthetic control chart for process variability based on sign statistic. Zombade and Ghute [14] provided nonparametric control charts for process variation based on Sukhatme's test and Mood's test. Shirke and Barale [15] proposed a nonparametric cumulative sum control chart for process dispersion using in-control deciles.

The existing nonparametric control charts are designed for monitoring location and scale by using separate control charts. Using two separate charts for monitoring location and scale can sometimes be difficult in practice for the interpretation of signals because the effect of changes in one of the parameters can affect the changes in other one. The joint monitoring scheme with single chart has received more attention in the recent literature due to simplicity and clarity. A single control chart uses a statistic that is a combination of two separate statistics one each for mean and variance. Joint monitoring of a process involves two parameters, the mean (location) and variance (scale) and typically uses an efficient statistic for monitoring each parameter. The control charts currently available for jointly monitoring the mean and variance are focused on parametric control chart. Cheng and Thaga [16] provided a review of literature on joint monitoring of control charts up to 2005. McCracken and Chakraborti [17] presented an overview of literature on joint monitoring control charts. They also discussed some of the joint monitoring schemes for multivariate processes, autocorrelated data, and individual observations. Most of the parametric control charts for joint monitoring the mean and variability of a process are based on the assumption that process distribution is normal. However, in many applications there is not always enough knowledge or information to support the assumption that process distribution is of specific shape or form such as normal. In such cases nonparametric control charts can be useful. The literature in the area of nonparametric joint monitoring schemes is currently very limited. A few nonparametric joint monitoring schemes are available in the literature. Zou and Tsung [18] developed EWMA control chart based on goodness-of-fit test. It has been shown that the proposed chart is effective for detecting changes in location, scale and shape. Mukherjee and Chakraborti [19] developed a single distribution-free control chart for joint monitoring of location and scale. The chart is based on nonparametric test for location-scale by Lepage [20] which combines the Wilcoxon rank sum (WRS) location statistic and with Ansari-Bradely scale statistic. Chowdhury et al. [21] proposed distribution-free chart based on Cucconi statistic, for joint monitoring of location and scale parameters of continuous distribution. Nonparametric joint monitoring scheme is an important area for research and literature in this area is currently very limited and thus presents a great opportunity for further research. The purpose of this paper is to contribute the research on nonparametric joint monitoring scheme.

In this paper, a single nonparametric Shewhart-type control chart is developed for joint monitoring of location and scale parameters of a continuous process distribution. The proposed chart is based on nonparametric two sample modified Lepage-type test proposed by Neuhäuser [22]. The test combines the Baumgartner statistic and Ansari-Bradely statistic for jointly detecting location and scale changes. The in-control and out-of-control performance of the proposed control chart is evaluated through average run length for the normal and double exponential distributions. The rest of the paper is organized as follows. The nonparametric Baumgartner and Ansari-Bradely tests for location and scale respectively are modified Lepage-type test proposed by Neuhäuser [22] for joint location and scale is are discussed in Section 2. A single nonparametric control chart for simultaneously monitoring the location parameter and the scale parameter of a process based on modified Lepage-type test statistic is presented in Section 3. In-control and out-of-control performance of the proposed control chart is studied in detail in Section 4. Performance of the proposed control chart is compared with the existing nonparametric charts in Section 5. Some conclusions are given in Section 6.

2. Nonparametric Tests for Location and Scale

In this section, we briefly discuss the nonparametric tests for location parameter, scale parameter and jointly location scale parameters.

2.1 Baumgartner two sample test for location

Baumgartner test is a two-sample test can be applied for location and scale parameters. Let $(X_1, X_2, \ldots, X_n)$ and $(Y_1, Y_2, \ldots, Y_m)$ denote two random samples. The observations within each sample are independent and identically distributed, and we assume independence between two samples. Let F and G be continuous distribution functions corresponding two populations1 and2 respectively. In location shift, model considered first the distribution functions are same except perhaps for change in their location; that is$F(x) = F(x-\theta)$. The null hypothesis is $H_0: \theta = 0$, whereas alternative is $H_1: \theta \neq 0$. Baumgartner et al. [23] proposed a distribution-free two-sample rank test for general alternative. For combined samples, let $R_1 < R_2 < \ldots < R_n$ and $H_1 < H_2 < \ldots < H_m$ denote the ranks of the $X-$values and $Y-$values in increasing order of magnitude, respectively. Baumgartner et al. [23] defined a nonparametric two-sample rank statistic B as follows:

$$B = \frac{B_X + B_Y}{2} \tag{1}$$

where $B_X = \frac{1}{n}\sum_{i=1}^{n} \frac{\left(R_i - \frac{N}{n} i\right)^2}{\frac{i}{n+1}\left(1-\frac{i}{n+1}\right)\left(\frac{m\,N}{n}\right)}$ and $B_Y = \frac{1}{m}\sum_{j=1}^{m} \frac{\left(H_j - \frac{N}{m} j\right)^2}{\frac{j}{m+1}\left(1-\frac{j}{m+1}\right)\left(\frac{n\,N}{m}\right)}$

The larger value of statistic B gives evidence to reject the null hypothesis. Baumgartner et al. [23] also provided asymptotic distribution of test statistic B.

2.2 Ansari-Bradely test for scale

The Ansari-Bradely test is a two-sample rank test applied for scale parameter. The test statistic is defined as follows: In the combined samples, the observations less than or equal to the median are replaced by their ranks in the increasing order and those larger than the median are replaced by their ranks in descending order. The statistic is the sum of these ranks for the Y sample. The corresponding test statistic is defined as (Gibbons and Chakraborti [24]),

$$AB = \sum_{k=1}^{n} \left(k - \frac{N+1}{2}\right) Z_k \tag{2}$$

The mean and variance of statistic AB is given by,

$$E(AB) = \begin{cases} \frac{m\,(N+1)}{4}, & \text{when N is even} \\ \frac{m\,(N+1)^2}{4N}, & \text{when N is odd} \end{cases} \quad \text{and} \quad V(AB) = \begin{cases} \frac{m\,n\,(N^2-4)}{48\,(N-1)}, & \text{when N is even} \\ \frac{m\,n\,(N+1)\,(N^2+3)}{48\,N^2}, & \text{when N is odd} \end{cases}$$

2.3 Modified Lepage-type test for location and scale

After Lepage statistic was proposed, various Lepage-type statistics have been proposed and discussed by many authors in the literature. One of the most famous and powerful modified Lepage-type statistic proposed by Neuhäuser [22] is a combination of the Baumgartner and Ansari-Bradely statistic given as:

$$L_M = \left(\frac{B - E_0(B)}{\sqrt{Var_0(B)}}\right)^2 + \left(\frac{AB - E_0(AB)}{\sqrt{Var_0(AB)}}\right)^2 \tag{3}$$

where B is Baumgartner statistic for location shift and AB is Ansari-Bradely statistic for scale shift. In this paper, we useL_M test statistic as a charting statistic for detecting simultaneous location and scale shifts in a continuous process distribution.

3. Control chart based on modified Lepage-type statistic

In this Section, we develop a nonparametric control chart based on modified Lepage-type test statistic proposed by Neuhäuser [22] for simultaneously monitoring the location and the scale parameters of a

continuous process. The single plotting statistic for the joint monitoring of location and scale is given by L_M in Eq. (3) and chart is called LM chart. To adopt the idea of two sample test for control chart implementation, m independent observations $(X_1, X_2, \ldots, X_m)$ from an in-control process are used as reference sample and compared to future sample subgroups of n independent observations $(Y_1, Y_2, \ldots, Y_n)$ an arbitrary test sample.

The proposed LM control chart for joint monitoring of location and scale is constructed as follows:

Step1: Collect Phase-I reference sample $X = (X_1, X_2, \ldots, X_m)$ of size$m$ from an in-control process.

Step2: Let $Y = (Y_1, Y_2, \ldots, Y_n)$ be j^{th} Phase-II (test) sample of size n , $j = 1, 2, 3, \ldots$

Step 3: Calculate B_j and$(AB)_j$ using (1) and (2) for j^{th} test sample.

Step 4: Compute means and standard deviations of B andAB statistics respectively

Step 5: Calculate the standardized B andABstatistics as

$$T_{1j} = \left(\frac{B - E_0(B)}{\sqrt{Var_0(B)}}\right) \text{ and } T_{2j} = \left(\frac{AB - E_0(AB)}{\sqrt{Var_0(AB)}}\right) \text{ respectively.}$$

Step 6: Calculate the control chart statistic LM chart as$T_j = T_{1j}^2 + T_{2j}^2$, $j = 1, 2, 3, \ldots$

Step 7: Plot T_j against an upper control limit$(UCL), H > 0$.

Step 8: If T_j exceed H, the process is out-of-control at the j^{th} test sample. If not, the process is thought to be in-control and testing continues to the next sample.

4. Performance evaluation and analysis of LM chart

Implementation of the proposed LM chart requires the upper control limit H. Typically, in practice, it is determined for some specified in-control average run length (ARL_0), say, 370 or 500. A Monte-Carlo simulation approach based on sufficiently large number of possible samples is used to determine H. For a given pair of (m, n) values, a search is conducted with different values of H, and that value of H is obtained for which $ARL_0$is equal to nominal (target) value. We choose $m = 30, 50, 100$ for the reference sample size and $n = 5, 11, 25$ as the test sample size and target values $ARL_0 = 200, 370, 500$. The results are presented in Table 1.

Table 1: *Charting constant H for the LM chart for some standard (target) values of* ARL_0

Reference sample size (m)	Test sample size (n)	Upper control limit (H)		
		$ARL_0 = 200$	$ARL_0 = 370$	$ARL_0 = 500$
30	5	29.540	35.242	37.960
30	11	25.050	33.128	37.312
30	25	16.985	22.089	24.820
50	5	14.510	19.510	22.390
50	11	15.389	18.712	20.752
50	25	15.798	19.123	20.910
100	5	20.020	29.050	32.800
100	11	20.740	27.490	31.305
100	25	18.540	24.450	28.023

The performance of a control chart is generally studied through its runlength distribution. If the runlength distribution is skewed to the right, it is useful to come across at various measures such as average run length (ARL), the standard deviation of run length (SDRL) and several percentiles including the first and third quartiles to characterize the distribution. We study the performance of the proposed LM chart both under in-control and out-of-control setup. For the in-control setup, we simulate both the reference and the test sample from standard normal distribution. We choose $m = 30, 50, 100$ and $n = 5, 11, 25$. For a given pair of (m, n) values, we obtain upper control limits H for nominal (target) $ARL_0 = 500$ and simulate different characteristics of the in-control run-length distribution. The results of simulation are shown in Table 2.

It indicates that the target $ARL_0 = 500$ is much larger than the median (Q_2) for all (m, n) combinations. Hence, in-control run-length distribution of the LM chart is highly skewed to the right.

In order to investigate the out-of-control performance of the proposed LM chart, we consider the underlying process distributions as normal and double exponential. The double exponential distribution is considered as process distribution to study the effect of heavy tailed distribution on the performance of the LM chart. The distribution of observations from the process is considered to have mean zero and variance one for both the process distributions under study.

Table 2: *In-control performance characteristics of the LM chart for* $ARL_0 = 500$.

m	n	H	ARL_0	$SDRL_0$	P_5	Q_1	Q_2	Q_3	P_{95}
30	5	37.960	501.0	500.5	26	146	350	694	1484
30	11	37.312	499.7	499.2	27	145	346	692	1493
30	25	24.820	500.4	499.9	26	144	347	695	1481
50	5	22.390	499.5	499.0	27	143	344	691	1508
50	11	20.752	501.4	500.9	26	144	351	698	1499
50	25	20.910	501.3	500.8	26	143	348	692	1502
100	5	32.800	500.6	500.1	26	144	348	696	1506
100	11	31.305	500.1	499.6	26	145	345	694	1499
100	25	28.023	502.9	502.4	26	147	349	695	1508

4.1 Performance analysis of LM chart under normal distribution

In order to investigate the out-of-control performance of the proposed LM chart, we consider the underlying process distribution as normal; samples are taken from $N(\theta, \lambda)$ distribution, with in-control samples coming from $N(0, 1)$distribution. To examine the effects of shifts in process parameters, 30 combinations of (θ, λ)values are considered with $\theta = 0, 0.25, 0.5, 1.0, 1.5, 2.0$ and $\lambda = 1.0, 1.25, 1.5, 1.75, 2.0$.

Tables 3 and 4 present the performance characteristics of the LM chart when underlying process distribution is normal with combinations of the reference and test sample sizes $m = 50, 100$ and $n = 5$.

The results in Table 3 and Table 4 indicate that the out-of-control run-length distributions are also skewed to right. It is observed that, for a fixed m, n and a given ARL_0, the out-of-control ARL values as well as the percentiles all decrease sharply with increasing shift in the location and also with the increasing shift in the scale. It indicates that the proposed LM chart is effective in detecting shifts in location and/or in the scale. The proposed LM chart detect shift in the scale more quickly than that in the location. For example, from Table 3, we observe that for 25% increase in location when scale is in-control, the ARL decreases by 68%, whereas for a 25% increase in a scale when the location is in-control, ARL decreases by 78%. Finally, when location and scale increases by 25% the ARL decreased by 88%. The pattern is same for SDRL; it decreases for an increase in the shift in both parameters, but decreases more for a shift in scale. For example, from Table 3, for 25% increase in location, the SDRL decreases by 68% but for 25% increase in scale, the SDRL decreases by 78%.

Table 3: *Performance characteristics of the LM chart for the normal distribution.* $(ARL_0 = 500, m = 50 \text{ and } n = 5)$.

θ	λ	ARL	SDRL	P_5	Q_1	Q_2	Q_3	P_{95}
0.0	1.0	499.5	499.0	27	143	344	691	1508
0.25	1.0	160.3	159.8	9	46	111	223	478
0.5	1.0	42.4	41.9	3	13	30	59	126
1.0	1.0	5.9	5.4	1	2	4	8	16
1.5	1.0	1.9	1.3	1	1	1	2	5
2.0	1.0	1.2	0.5	1	1	1	1	2
0.0	1.25	108.1	107.6	6	31	76	150	322
0.25	1.25	58.4	57.9	3	17	41	81	175
0.5	1.25	24.1	23.6	2	7	17	33	72
1.0	1.25	5.7	5.1	1	2	4	8	16
1.5	1.25	2.2	1.7	1	1	2	3	6
2.0	1.25	1.3	0.7	1	1	1	2	3
0.0	1.5	43.0	42.5	3	13	30	60	127

0.25	1.5	30.6	30.1	2	9	21	42	90
0.5	1.5	16.6	16.1	1	5	12	23	48
1.0	1.5	5.5	4.9	1	2	4	7	15
1.5	1.5	2.5	1.9	1	1	2	3	6
2.0	1.5	1.5	0.9	1	1	1	2	3
0.0	1.75	22.8	22.3	2	7	16	31	68
0.25	1.75	18.8	18.2	1	6	13	26	55
0.5	1.75	12.7	12.2	1	4	9	17	37
1.0	1.75	5.3	4.8	1	2	4	7	15
1.5	1.75	2.7	2.2	1	1	2	4	7
2.0	1.75	1.7	1.1	1	1	1	2	4
0.0	2.0	14.5	14.0	1	5	10	20	42
0.25	2.0	13.1	12.6	1	4	9	18	39
0.5	2.0	9.9	9.4	1	3	7	13	29
1.0	2.0	5.1	4.6	1	2	4	7	14
1.5	2.0	2.9	2.3	1	1	2	4	8
2.0	2.0	1.9	1.3	1	1	1	2	4

Table 4: *Performance characteristics of the LM chart for normal distribution.* ($ARL_0 = 500,\ m = 100\ and\ n = 5$).

θ	λ	ARL	SDRL	P_5	Q_1	Q_2	Q_3	P_{95}
0.0	1.0	500.6	500.1	26	144	348	696	1506
0.25	1.0	273.6	273.1	15	79	191	380	814
0.5	1.0	66.4	65.9	4	20	46	91	199
1.0	1.0	7.5	7.0	1	3	5	10	21
1.5	1.0	2.1	1.5	1	1	2	3	5
2.0	1.0	1.2	0.5	1	1	1	1	2
0.0	1.25	119.9	119.4	7	35	83	166	355
0.25	1.25	83.8	83.3	5	25	58	116	251
0.5	1.25	33.3	32.8	2	10	23	46	98
1.0	1.25	6.8	6.3	1	2	5	9	19
1.5	1.25	2.4	1.9	1	1	2	3	6
2.0	1.25	1.4	0.7	1	1	1	2	3
0.0	1.5	48.6	48.1	3	14	34	67	145
0.25	1.5	39.6	39.1	2	12	27	55	118
0.5	1.5	21.5	21.0	2	7	15	30	63
1.0	1.5	6.4	5.9	1	2	5	9	18
1.5	1.5	2.7	2.2	1	1	2	4	7
2.0	1.5	1.6	1.0	1	1	1	2	4
0.0	1.75	26.3	25.8	2	8	18	36	78
0.25	1.75	23.3	22.8	2	7	16	32	69
0.5	1.75	15.5	15.0	1	5	11	21	45
1.0	1.75	6.1	5.6	1	2	4	8	17
1.5	1.75	2.9	2.4	1	1	2	4	8
2.0	1.75	1.8	1.2	1	1	1	2	4
0.0	2.0	16.5	16.0	1	5	12	23	49
0.25	2.0	15.4	14.9	1	5	11	21	45
0.5	2.0	11.8	11.3	1	4	8	16	35
1.0	2.0	5.8	5.2	1	2	4	8	16

1.5	2.0	3.1	2.5	1	1	2	4	8
2.0	2.0	2.0	1.4	1	1	1	2	5

4.2 Performance analysis of LM chart under double exponential distribution

To study the effect of heavy tailed distribution on the performance of the proposed LM chart, double exponential distribution is included in the study as heavy tailed process distribution. We conduct simulation study with data from double exponential distribution. The performance characteristics of the run-length are evaluated when the in-control sample is from double exponential with mean 0 and variance 1, and test samples are generated from the double exponential distribution with mean θ and standard deviation λ.

To examine the effects of shifts in location and scale, as in normal case, we studied 30 combinations of (θ, λ)values. Table 5 and Table 6 presents the performance characteristics of the proposed LM chart when underlying process distribution is double exponential with combinations of reference and test samples of size $m = 50, 100$and $n = 5$.

Table 5: *Performance characteristics of LM chart for double exponential distribution.* $(ARL_0 = 500, m = 50 \; and \; n = 5)$.

θ	λ	ARL	SDRL	P_5	Q_1	Q_2	Q_3	P_{95}
0.0	1.0	499.6	499.1	25	143	345	693	1505
0.25	1.0	91.5	91.0	5	27	64	127	272
0.5	1.0	18.2	17.7	1	6	13	25	53
1.0	1.0	3.0	2.4	1	1	2	4	8
1.5	1.0	1.5	0.8	1	1	1	2	3
2.0	1.0	1.1	0.4	1	1	1	1	2
0.0	1.25	222.2	221.7	12	64	155	307	663
0.25	1.25	59.7	59.2	4	18	42	82	178
0.50	1.25	17.0	16.5	1	5	12	23	50
1.0	1.25	3.6	3.0	1	1	3	5	10
1.5	1.25	1.7	1.1	1	1	1	2	4
2.0	1.25	1.3	0.6	1	1	1	1	2
0.0	1.5	128.6	128.1	7	38	90	177	381
0.25	1.5	45.5	45.0	3	14	32	63	136
0.5	1.5	16.1	15.6	1	5	11	22	47
1.0	1.5	4.2	3.6	1	2	3	6	11
1.5	1.5	2.0	1.5	1	1	2	3	5
2.0	1.5	1.4	0.8	1	1	1	2	3
0.0	1.75	87.1	86.6	5	26	61	121	261
0.25	1.75	37.0	36.5	2	11	26	51	110
0.50	1.75	15.8	15.3	1	5	11	22	46
1.0	1.75	4.7	4.2	1	2	3	6	13
1.5	1.75	2.3	1.8	1	1	2	3	6
2.0	1.75	1.6	1.0	1	1	1	2	4
0.0	2.0	65.0	64.5	4	19	45	90	193
0.25	2.0	31.8	31.3	2	10	22	44	94
0.50	2.0	15.4	14.9	1	5	11	21	45
1.0	2.0	5.2	4.7	1	2	4	7	14
1.5	2.0	2.6	2.1	1	1	2	3	7
2.0	2.0	1.8	1.2	1	1	1	2	4

Table 6: *Performance characteristics of LM chart for double exponential distribution* $(ARL_0 = 500, \quad m = 100 \; and \; n = 5)$.

θ	λ	ARL	SDRL	P_5	Q_1	Q_2	Q_3	P_{95}
0.0	1.0	497.9	497.4	25	142	344	691	1502
0.25	1.0	789.9	789.4	42	225	546	1098	2376
0.5	1.0	194.6	194.1	10	56	134	269	583
1.0	1.0	10.5	10.0	1	3	7	14	30
1.5	1.0	2.2	1.6	1	1	2	3	5
2.0	1.0	1.2	0.5	1	1	1	1	2
0.0	1.25	179.6	179.1	10	52	125	249	536
0.25	1.25	246.2	245.7	13	71	170	341	739
0.5	1.25	91.5	91.0	5	27	64	126	272
1.0	1.25	9.6	9.1	1	3	7	13	27
1.5	1.25	2.5	2.0	1	1	2	3	6
2.0	1.25	1.4	0.7	1	1	1	2	3
0.0	1.5	91.1	90.6	5	26	64	127	272
0.25	1.5	111.4	110.9	6	32	77	154	332
0.5	1.5	55.5	55.0	3	16	38	77	164
1.0	1.5	9.3	8.7	1	3	7	13	27
1.5	1.5	2.8	2.3	1	1	2	4	7
2.0	1.5	1.5	0.9	1	1	1	2	3
0.0	1.75	54.4	53.9	3	16	38	75	162
0.25	1.75	63.3	62.8	4	19	44	88	188
0.5	1.75	37.8	37.3	2	11	26	52	112
1.0	1.75	8.7	8.2	1	3	6	12	25
1.5	1.75	3.1	2.5	1	1	2	4	8
2.0	1.75	1.7	1.1	1	1	1	2	4
0.0	2.0	36.7	36.2	2	11	26	51	109
0.25	2.0	41.2	40.7	3	12	29	57	123
0.5	2.0	27.9	27.4	2	8	20	39	83
1.0	2.0	8.3	7.8	1	3	6	11	24
1.5	2.0	3.3	2.7	1	1	2	4	9
2.0	2.0	1.8	1.2	1	1	1	2	4

From Tables 5 and 6, it is observed that when underlying process distribution is doubling exponential, the general pattern remains the same as in the case of normal distribution. However, the out-of-control ARL values for detecting a shift in the mean and/or variance under double exponential distribution are larger than that of the ARL values under normal process distribution. For example, from Table 6, mean shift is 50% ($\theta = 0.50$) and dispersion shift is 50% ($\lambda = 1.5$), The ARL is 194.6 which is larger than 66.4 in the normal case of Table 4. It indicates that the proposed LM chart detects shifts in process location and scale slower under heavy tailed distribution. Moreover, the percentiles as well as SDRL all increase under double exponential distribution as compared with normal distribution.

5. Performance comparison with existing control charts

In this section, the performance of the proposed LM chart is compared with that of the SL chart by Mukherjee and Chakraborti [19] and SC chart by Chowdhury et al. [21] when underlying process distributions are normal and double exponential. Table 7 presents the ARL performance of SC chart, SL chart and LM chart for normal distribution with reference sample size $m = 50, 100$ and test sample of size $n = 5$.

Table7: *Performance comparisons between SC, SL and LM charts for the normal distribution with* $ARL_0 = 500$.

θ	λ	$m = 50, n = 5$			$m = 100, n = 5$		
		SC chart	SL chart	LM chart	SC chart	SL chart	LM chart
0.0	1.0	497.3	499.6	499.5	509.4	513.0	500.6
0.5	1.0	92.2	94.7	42.4	68.6	66.5	66.4
1.0	1.0	8.5	9.3	5.9	7.7	7.7	7.5
1.5	1.0	2.2	2.3	1.9	2.1	2.1	2.1
2.0	1.0	1.2	1.3	1.2	1.2	1.2	1.2
0.0	1.25	71.1	106.2	108.1	74.5	102.9	119.9
0.5	1.25	27.6	35.4	24.1	26.2	30.9	33.3
1.0	1.25	6.6	7.4	5.7	6.2	6.7	6.8
1.5	1.25	2.4	2.6	2.2	2.4	2.5	2.4
2.0	1.25	1.4	1.4	1.3	1.3	1.4	1.4
0.0	1.5	22.8	36.82	43.0	24.3	37.5	48.6
0.5	1.5	13.3	19.0	16.6	13.4	17.8	21.5
1.0	1.5	5.2	6.5	5.5	5.3	6.1	6.4
1.5	1.5	2.4	2.8	2.5	2.4	2.7	2.7
2.0	1.5	1.5	1.6	1.5	1.5	1.6	1.6
0.0	1.75	10.9	18.5	22.8	11.7	19.1	26.3
0.50	1.75	8.1	12.1	12.7	8.4	12.1	15.5
1.0	1.75	4.4	5.7	5.3	4.4	5.5	6.1
1.5	1.75	2.5	2.9	2.7	2.4	2.8	2.9
2.0	1.75	1.6	1.8	1.7	1.6	1.8	1.8
0.0	2.0	6.6	11.3	14.5	7.1	11.5	16.5
0.5	2.0	5.5	8.5	9.9	5.8	8.6	11.8
1.0	2.0	3.7	4.9	5.1	3.8	4.8	5.8
1.5	2.0	2.4	2.9	2.9	2.4	2.9	3.1
2.0	2.0	1.7	1.9	1.9	1.7	1.9	2.0

Examination of Table 7 that for normal distribution leads the following findings:

- For location shifts only when the scale parameter is in-control, the proposed LM chart performs better than the SL and SC charts.
- For scale shifts only when the location parameter is in-control, the proposed LM chart is not as much better as the SL and SC charts.
- For reference sample of size $m = 50$, for any given shift in location parameterθ with a fixed shift in scale parameter as $\lambda = 1.25$, the proposed LM chart performs better than the SL and SC charts. As shift in scale parameter λincreases to 1.5 with any given shift in location parameter θ, the proposed LM chart is efficient than the SL chart only. For scale shift of size $\lambda = 1.25$ and location shift $\theta = 1.5$ and 2.0the proposed LM chart is efficient than the SL chart only. For scale shift $\lambda = 2.0$ and location shift $\theta = 1.5$ and 2.0the proposed LM chart is equally efficient to the SL chart only.

- For reference sample of size $m = 100$, for detecting shift in location parameter as $\theta = 1.5$ and 2.0and shift in scale parameter $\lambda = 1.5\ and\ 1.5$ the proposed LM chart is equally efficient to the SL chart only.

Table 8: *Performance comparison between the SC, SL and LM charts for the double exponential distribution with* $ARL_0 = 500$.

θ	λ	$m = 50, n = 5$			$m = 100, n = 5$		
		SC chart	SL chart	LM chart	SC chart	SL chart	LM chart
0.0	1.0	492.7	493.2	499.6	509.6	508.3	497.9
0.5	1.0	240.0	235.2	18.2	191.0	159.2	194.6
1.0	1.0	41.4	36.1	3.0	26.5	19.9	10.5
1.5	1.0	7.2	5.93	1.5	4.8	4.1	2.2
2.0	1.0	2.1	2.0	1.1	1.8	1.7	1.2
0.0	1.25	118.0	156.8	222.2	124.5	153.2	179.6
0.5	1.25	69.7	79.8	17.0	61.7	66.19	91.5
1.0	1.25	20.1	19.9	3.6	14.6	14.0	9.6
1.5	1.25	5.1	5.2	1.7	4.4	4.2	2.5
2.0	1.25	2.1	2.2	1.3	2.0	2.0	1.4
0.0	1.5	43.3	65.9	128.6	47.8	66.8	91.1
0.5	1.5	29.3	42.1	16.1	29.6	36.8	55.5
1.0	1.5	12.0	14.2	4.2	10.7	11.1	9.3
1.5	1.5	4.5	4.7	2.0	4.0	4.1	2.8
2.0	1.5	2.2	2.3	1.4	2.1	2.2	1.5
0.0	1.75	22.8	35.6	87.1	24.4	36.4	54.4
0.5	1.75	16.7	24.5	15.8	16.9	23.2	37.8
1.0	1.75	8.5	10.4	4.7	7.9	9.2	8.7
1.5	1.75	4.0	4.5	2.3	3.7	4.0	3.1
2.0	1.75	2.2	2.4	1.6	2.1	2.3	1.7
0.0	2.0	13.8	22.1	65.0	14.5	22.9	36.7
0.5	2.0	11.1	17.0	15.4	11.3	16.6	27.9
1.0	2.0	6.5	8.6	5.2	6.3	7.9	8.3
1.5	2.0	3.5	4.3	2.6	3.5	3.9	3.3
2.0	2.0	2.2	2.5	1.8	2.1	2.3	1.8

Examination of Table 8 that for double exponential distribution leads the following findings:

- For reference sample of size $m = 50$, for location shifts only when the scale parameter is in-control, the proposed LM chart performs better than the SL and SC charts. For scale shifts only when the location parameter is in-control, the proposed LM chart is not as better as the SL and SC charts. For any given shift in location parameter θ with any shift in scale parameter λ, the proposed LM chart performs better than the SL and SC charts.
- For reference sample of size $m = 100$, for detecting shift in location parameter as $\theta = 1.0$ and 2.0 and shift in scale parameter $\lambda = 1.25, 1.5$ and 1.75, the proposed LM chart is efficient than the to the SL and SC charts. For detecting shift in location parameter as $\theta = 1.0$ and 2.0 and shift in scale parameter $\lambda = 2.0$, the proposed LM chart is efficient than the to the SL and SC charts.

6. Conclusions

In this paper, a single nonparametric control chart based on modified Lepage-type test statistic is developed for joint monitoring of location and scale parameters of a continuous process distribution. Both in-control and out-of-control performance of the chart are studied under normal and heavy tailed double exponential distributions. The various performance characteristics such as mean, median and some percentiles of the run-length distribution are examined. It is observed that the proposed LM chart maintain its designed in-control ARL under the considered process distributions. The chart is found to be more efficient under normal distribution as compared to double exponential distribution. The performance of the proposed chart is compared with SL chart by Mukherjee and Chakraborti [19] and SC chart by Chowdhury [21]. It is observed

that the proposed LM chart for joint monitoring of location and scale performs better than the SL and SC charts in some situations.

Acknowledgment

The authors would like to thank the editor for his comments and suggestions which contributed to the improvement of this article.

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NEW SAMPLING STRATEGY FOR ESTIMATING CAPABILITY INDICES FOR AUTOCORRELATED DATA.

- **Source:** International Journal of Agricultural & Statistical Sciences . Jan2023, Vol. 19 Issue 1, p1-7. 7p.

- **Author(s):** Deshpande, M. M.; Ghute, V. B.

- **Abstract:** Process capability index is an important measure to evaluate the capability of the manufacturing process. Many of the process capability indices available in the literature are based on assumption of independence and normality of the process output characteristic. Shore (1997) among others has reported that ignoring the autocorrelation in the process characteristics can lead to wrong decisions. In this paper, the effect of the autocorrelation on commonly used capability indices C_p and C_{pk} is discussed. The first-order autoregressive process AR(1) is considered to model the data from an autocorrelated process. To reduce the effect of autocorrelation on these indices, the skip and mixed sampling techniques are implemented to form rational subgroups in the design of these indices. Results based on simulation study confirm that both the techniques improve estimates of capability indices significantly.

Dr. Vikas B. Ghute

MOVING AVERAGE AND DOUBLE MOVING AVERAGE CONTROL CHARTS FOR PROCESS VARIABILITY USING AUXILIARY INFORMATION

Authors: Vikas Ghute, Sarika Pawar

Publication date: 2023

Journal: Reliability: Theory & Applications

Volume: 18

Issue: 3 (74)

Pages: 825-840

Publisher: Интернет-сообщество Gnedenko Forum

Description: The memory type control charts based on auxiliary information have been introduced in the literature for improved monitoring of the process parameters for normally distributed process. In this paper, we design moving average and double moving average control charts based on auxiliary information for efficient monitoring the shifts in the process variability. Regression estimator of process variance in the form of auxiliary and study variables is considered to construct charting statistics for the proposed charts. The average run length (ARL) and standard deviation of run length (SDRL) performance of the proposed charts is investigated using simulation study and is compared with the originally proposed Shewhart control charts based on auxiliary information and without auxiliary information. The proposed auxiliary information based moving average and double moving average charts are found to be efficient for monitoring the process variance of normally distributed process. An illustrative example based on simulated data set is provided to show the implementation of the proposed charts in detecting shifts in the process standard deviation.

Process capability index C_{pm} under autoregressive process AR (2)

Vikas Ghute, Mahesh Deshpande

International Journal of Quality & Reliability Management
ISSN: 0265-671X
Article publication date: 24 November 2023

Series: Advances in Computer Science Research

Proceedings of the International Conference on Applications of Machine Intelligence and Data Analytics (ICAMIDA 2022)

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Fruit Detection and Identification from Realtime Video Sequences: A Review

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Print ISSN : 2277 - 7830 Online ISSN : 2348 - 5922 indexed with J Gate,i scholar and Google scholar
IBMRD's Journal of Management & Research
Biannual Peer reviewed Blind fold Journal

Cyber Security Awareness: A Movement of Digital Literacy Towards making of Digital India

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DOI: 10.17697/ibmrd/2022/v11i2/172617

JIMS 8i-International Journal of Information, Communication and Computing Technology (IJICCT)

Volume 10, Issue 1: (Jan-June 2022)

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A NEW CONTROL CHART FOR PROCESS DISPERSION BASED ON RANKED SET SAMPLING

Chandrakant Gardi, Vikas Ghute
Department of Statistics Punyashlok Ahilyadevi Holkar Solapur University, Solapur (MS), India
chandrakant.gardi@gmail.com, vbghute_stats@rediffmail.com

In this paper, we propose a new control chart based on Downton's estimator (D) for monitoring the process dispersion using ranked set sampling design and runs rules. The performance of the proposed control chart is compared with the originally proposed D chart based on simple random sampling method when underlying process distribution is normal and non-normal. The average run length is used to evaluate the performance of the proposed control chart. It is observed that the proposed control chart is efficient in detecting shifts in process dispersion as compared with the chart using simple random sampling method. The performance of the proposed chart is further investigated using runs rules. The efficiency of the designed runs rules RSS-D chart is compared with its existing counterparts and is found to be superior.

Keywords: Control chart, Average run length, Process dispersion, Ranked set sampling, Runs rules, Downton estimator.

PDF

Cite: Chandrakant Gardi, Vikas Ghute A NEW CONTROL CHART FOR PROCESS DISPERSION BASED ON RANKED SET SAMPLING. *Reliability: Theory & Applications.* **2023**, *June 2(73):* 24-38. https://doi.org/10.24412/1932-2321-2023-273-154-166

MODELING THE RELIABILITY OF TRANSPORT UNDER EXTREME CONDITIONS OF OPERATION AS A QUEUING SYSTEM WITH PRIORITIES

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Case Studies in Chemical and Environmental Engineering
Volume 8, December 2023, 100380

Case Report

Surface plasmon resonance based colorimetric probe for vitamin B_1 detection: Applications to bio-fluid analysis

Uttam R. Kondekar [a], Laxman S. Walekar [b], Samadhan P. Pawar [a c], Mukund G. Mali [b], Dilip D. Anuse [d], Chandrakant G. Gardi [a], Shamkumar Deshmukh [f], Prashant V. Anbhule [c], Govind B. Kolekar [a]

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Title : A STUDY ON DIFFERENT KINDS OF NOISE MODELS AND NOISE REMOVAL FILTERING TECHNIQUES FOR REAL LIFE IMAGE

Lalita Gavhanel, Rajivkumar Mente2, Bapu Chendage3

Abstract :

In recent years, the use of digital images has increased drastically in various domains in life such as medical, military, scientific and other. Images are often degraded by noises. During image capture, transmission noise can obtained or occurred. This noise affects the quality of image and loss of important information, so it is very important to remove these noises with preserving the image as much as possible. Noise removal technique play important role in the field of image processing. In image processing noise removal is an important task. By using noise removal techniques that is image filtering techniques, the quality of the image remains as it is. In this paper four types of noise such as Gaussian noise, Salt & Pepper noise, Speckle noise and Poisson noise are used to remove the noise from an image. Different filters such as Mean filter, Median filter and Wiener filter are used to remove noise.

Rajivkumar Mente

A Study of the Image Modalities used in Computer Aided Detection and Diagnosis

Authors Rajivkumar Mente Suhas Kulkarni
Publication date 2023/1
Journal Industrial Engineering Journal
Volume 52
Issue 1
Pages 90-96
Publisher Industrial Engineering Journal

Jyoti Thenge-Mashale

Soft Graph: A new Approach

Autori J. D Mashale V. A. Koli

Data pubblicazione 2023/4

Libro Recent Trends in Humanities, Social Sciences, Sciences and Commerce

Volume 1

Pagine 19-23

Jyoti Thenge-Mashale

A Study on Soft graph

Autori R.S. Jain J.D.Mashale, B.Surendranath Reddy

Data pubblicazione 2023/8

Libro Research in Multidisciplinary Subjects

Volume 4

Pagine 89-96

Editore The Hill Publication, Purulia, West Bengal, 723121

School of Languages & Literatures

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ماہنامہ
تحریک ادب
UGC Care Listed
شمارہ ۶۵ (مئی ۲۰۲۳ء)
Tahreek-e-Adab
ISSN 2322-0341
A Peer Reviewed
Refereed Literary And Research Journal
website: www.tahreekeadab.com
e-mail: tahreekeadab2008@gmail.com
e-mail: jawedanwar@gmail.com
Cell: +91-9935957330
مدیر
جاوید انور (ڈاکٹر جاوید احمد)

REGISTERED WITH R.N.I. No. UPURD/04426/24/1/2010-TC

ISSN 2322-0341
Vol. 16

Tabreek - e - Adab

A Peer Reviewed, Refereed Literary And Research Journal

Urdu Monthly

Issue 65

May 2023

URDU ASHIANA
167 Afaq Khan Ka Ahata, Manduadih Bazar, Varanasi-221103(U.P)

گورنمنٹ ایس پی ایم آر کالج آف کامرس (جموں) کی حالیہ علمی، ادبی اور ثقافتی سرگرمیاں

Syed Suleman Nadvi ki Ilmi-o-Adabi Khidmaat ka Jaeza by Dr. Sumayya Bagban(Asst.Prof dept.of Urdu PAH Sholapur University Sholapur)cell-9767387202

ڈاکٹر سمیہ باغبان (اسسٹنٹ پروفیسر شعبہ اردو، پُنیہ شلوک اہلیادیوی ہولکر یونیورسٹی، سولاپور)

سید سلیمان ندوی کی علمی وادبی خدمات کا جائزہ

اردو کے نامور سیرت نگار عالم دین اور مورخ سید سلیمان ندوی کی پیدائش پٹنہ کے ایک قصبہ دیسنہ میں 22 نومبر 1884ء کو ہوئی. والد محترم حکیم سید ابوالحسن ایک صوفی منش انسان تھے. تعلیم کا آغاز خلیفہ انور علی اور مقصود علی سے کیا اپنے بڑے بھائی حکیم سید ابوحبیب سے بھی تعلیم وتربیت حاصل کی 1899ء میں پھلواری شریف بہار چلے گئے وہاں خانقاہ مجیبیہ کے مولانا محی الدین اور شاہ سلیمان پھلواری سے وابستہ ہوگئے پھر یہاں سے وہ دربھنگا چلے گئے اور مدرسہ امدادیہ میں چند ماہ مقیم رہے۔ 1901ء میں لکھنؤ کے مدرسہ دارالعلوم ندوالعلماء میں داخلہ لیا اور سات سال تک تعلیم حاصل کی۔ اسی زمانے میں مولانا شبلی نعمانی کے حلقہ درس میں شامل ہوئے اور جب حصول علم سے فراغت حاصل کی تو اسی ادارے سے وابستہ ہوگئے 1913ء میں دکن کالج پونہ میں معلم السنہ شرقیہ مقرر ہوئے۔ 1940ء میں علی گڑھ مسلم یونیورسٹی سے ڈاکٹریٹ کی اعزازی سند حاصل کی.

عالم اسلام کو جن علماء پر ناز ہے ان میں سے ایک سید سلیمان ندوی بھی شامل ہیں سید سلیمان ندوی اور اردو ادب کے نامور سیرت نگار عالم دین مؤرخ اور چند قابل قدر تصانیف کے مصنف کی حیثیت سے جانے جاتے ہیں. شبلی نعمانی کے شاگردوں میں سید سلیمان ندوی کو کافی اہم مقام حاصل تھا۔ علامہ شبلی نعمانی کے ندوالعلماء کے قیام کے دوران عمادالملک نے ندوالعلماء کے کام سے متاثر ہوکر اپنا بیش قیمت کتب خانہ ندوہ کو دینے کا فیصلہ کیا اس کتب خانے کو حیدرآباد سے لانے کے لیے مولانا شبلی نعمانی نے سید سلیمان ندوی کا انتخاب کیا تھا۔ شبلی نعمانی کے انتقال کے وقت سید سلیمان ندوی دکن کالج پونہ میں لیکچرار کی حیثیت سے کام کررہے تھے شبلی نعمانی نے ان کو وصیت کی کہ سب کام چھوڑ کر سیرت النبی کی تکمیل اور اشاعت کا فرض ادا کریں اسی وقت سید سلیمان ندوی نے ملازمت ترک کی اور دو اہم کاموں کی تکمیل طرف متوجہ ہوئے۔ جن میں ایک سیرت النبی کی

تصنیف تھی۔ سید سلیمان ندوی کی شخصیت علمی جامعیت کا سب سے شاندار مظہر ہے ان کے علمی و ادبی خدمات و کمالات کو ایک مختصر مقالے میں تو کیا ضخیم کتابوں میں بھی تحریر نہیں کیا جا سکتا وہ بیک وقت عالم بھی ہیں شاعر بھی ہیں صاحب طرز انشا پرداز مورخ جغرافیہ داں لسانیات کے رمز شناس اور عمرانیات کے زود فہم بھی تھے. اس کے علاوہ نقاد محقق صحافی علوم اسلامیہ کے ماہر بہترین مقرر اور خطیب بھی تھے.

علامہ اقبال نے سید سلیمان ندوی کی علمی و ادبی خدمات کا اعتراف کرتے ہوئے کہا ہے کہ:

"آج سید سلیمان ندوی ہماری عملی زندگی کے سب سے اونچے زینے پر ہے وہ عالم ہی نہیں امیر علماء ہے۔ مصنف ہی نہیں رئیس المصنفین ہیں ان کا وجود علم و فضل کا ایک دریا ہے جس سے سینکڑوں نہریں نکلیں ہیں اور ہزاروں سوکھی کھیتیاں سیراب ہوئی ہیں"

علوم قرآن، تفسیر، حدیث، سیرت، فنی رجال، تاریخ اسلام، تاریخ افکار، اسلامی منطق و فلسفہ، علم الکلام، علم لغت، غرض ماضی کے شاندار تہذیبی ورثے کا کوئی ایسا اہم پہلو نہ رہا ہوگا جس میں سید سلیمان ندوی نے اپنے بصیرت اور گہری فراست کا ثبوت نہ دیا ہو. ان کی علمی و ادبی عظمت کا اندازہ اس بات سے بھی لگایا جا سکتا ہے کہ ان کے استاد علامہ شبلی نعمانی نے سیرت النبی کی پہلی دو جلدیں لکھ کر وفات پا گئے تو باقی چار جلدیں آپ نے مکمل کی. سید سلیمان ندوی ایک اچھے مقرر اور خطیب بھی تھے انہیں تقریر و خطابت پر پوری قدرت حاصل تھی ان کی تقریر کے متعلق ڈاکٹر محمد نعیم صدیقی ندوی لکھتے ہیں کہ :

"لکھنو کے "رفاہ عام کلب" میں انہوں نے "علوم قدیم و جدید کا موازنہ" کے موضوع پر اردو میں اور "ہندوستان میں اسلام کی اشاعت کیوں کر ہوئی" کے موضوع پر عربی میں برجستہ ایسی پرزور تقریر کی کہ پورا جلسہ نعرہ تحسین و آفرین سے گونج اٹھا اور علامہ شبلی فرط انبساط سے اپنا عمامہ سر سے اتار کر عزیز شاگرد کے سر پر رکھ دیا".

اردو زبان تو آپ کے گھر کی زبان تھی. فارسی اور عربی پر بھی مکمل عبور حاصل تھا انگریزی پر دسترس رکھتے تھے۔ ذیل میں آپکی علمی ادبی تصانیف کا اجمالی جائزہ درج ہے۔ لغات جدیدہ، ارض القرآن، سیرت النبی، سیرت عائشہ، خطبات مدارس، عرب و ہند کے تعلقات، عربوں کی جہاز رانی، خیام، نقوش سلیمانی، رحمت عالم، حیات شبلی، مقالات سلیمان، مکتوبات سلیمان۔

لغات جدیدہ: 1910ء میں ندوۃ العلماء کے سالانہ اجلاس منعقدہ دہلی میں طے ہوا کہ عربی کے جدید الفاظ کی ایک ایک لغت ترتیب دی جائے چنانچہ یہ کام مولانا سید سلیمان ندوی صاحب کے سپرد

کیا گیا جسے مولانا سید صاحب نے دو برس میں پورا کر کے 1912ء کے اجلاس لکھنؤ میں جس کے صدر علامہ رشید رضا مصری تھے پیش کیا. یہی ڈکشنری "لغات جدیدہ" کے نام سے 1912ء ہی میں طبع ہو کر شائع ہوئی۔ اس تصنیف میں عربی زبان کے تقریباً ان چار ہزار الفاظ کی تشریح و تحقیق جو آج کل عربی میں استعمال ہوتے ہیں اور جن کے بغیر عربی پڑھنے والے، عربی اخبارات و رسائل اور جدید تصنیفات سے مستفیض نہیں ہو سکتے۔ اس تصنیف میں عربی الفاظ پر محققانہ بحث کی گئی ہے۔ اس کتاب میں صرف دخیل اور مولد الفاظ لیے گئے ہیں جو اب تک مستعمل ہیں اور کتب لغاتِ قدیمہ میں مدون نہ ہوئے اور جو الفاظ اب تک متروک ہیں یا لغات میں ملتے ہیں ان کی ضرورت نہیں سمجھی گئی ہے۔ لیکن اتمام فائدہ کی غرض سے ان الفاظ کا آخر میں ضمیمہ دیا گیا ہے۔

ارض القرآن: کالج پونا کے زمانہ قیام کے دوران سید سلیمان ندوی نے اس تصنیف کا آغاز کیا تھا. اس میں قدیم عرب کے جغرافیہ اقوام عرب کی پرانی مذہبی تمدنی تاریخ بیان کی گئی ہے شاہ معین الدین کا کہنا ہے کہ:

"یہ درحقیقت سیرت النبی جلد اول کا مقدمہ ہے مگر چونکہ یہ زیادہ طویل ہو گیا. اسلیے اس کا صرف خلاصہ سیرت میں لیا گیا ہے" (شاہ معین الدین۔ حیات سلیمان ص 67)

یہ کتاب دو جلدوں پر مشتمل ہے۔ اس کی پہلی جلد 1917ء اور دوسری جلد 1918ء میں دارالمصنفین سے شائع ہوئی. دوسری جلد میں عرب کی قوموں کے لسانی، مذہبی، تجارتی اور تمدنی حالات پر بحث کی گئی ہے۔ 1936ء میں مولوی مظفر الدین ندوی نے اس کا انگریزی میں ترجمہ کیا۔

سیرت النبی (جلد سوم تا ششم): سیرت النبی کی تصنیف کی شروعات مولانا شبلی نعمانی کی تھی۔ سیرت النبی کا حصہ اول اور دوم شبلی نعمانی نے لکھا تھا مگر حصہ دوم کا مسودہ میں جا بجا بیاضیں چھوٹی ہوئی تھی. سید سلیمان ندوی نے اسے مکمل کیا اور 1920ء میں اس کو شائع کیا۔ اسی زمانہ میں سیرت کی تیسری جلد لکھی جس میں معجزہ کی حقیقت، اس کے امکان و وقوع پر فلسفہ قدیم، علم کلام، فلسفہ جدید اور قرآن کے نقطہ ہائے نظر سے مبسوط تبصرہ ہے۔ یہ جلد 1924ء میں شایع ہوئی۔ اس کے بعد 1934ء میں چوتھی جلد شائع ہوئی. اس کا موضوع منصب نبوت ہے. اس تصنیف میں نبوت محمدی نے دنیا میں کس عظیم الشان اصلاح کا فرض انجام دیا ہے. اس جلد کے شائع ہونے سے دارالمصنفین اور زیادہ شہرت کا باعث بنا. سیرت النبی کی پانچویں جلد 1935ء میں شائع ہوئی. اس کا موضوع عبادات ہے. اور چھٹی جلد 1939ء میں منظر عام پر آئی. اس میں اخلاقی تعلیمات کی تفصیل بیان کی گئی ہے. سیرت

النبی کی تمام جلدیں ہند و بیرون ہند میں بے حد مشہور و مقبول ہوئیں. ترکی، پشتو، عربی، اور انگریزی زبانوں میں اس کے ترجمے بھی ہو چکے ہیں.

سیرت عائشہ:۔ سید سلیمان ندوی نے اس کتاب کا آغاز طالب علمی کے زمانے میں ہی کیا تھا مگر اس کی تکمیل بعد میں ہوئی یہ کتاب 1924ء میں شائع ہو کر منظر عام پر آئی. ڈاکٹر اقبال کے مطالعے سے جب یہ کتاب گزری تو انہوں نے ایک خط میں سید سلیمان صاحب کو تحریر فرمایا:

"سیرت عائشہ کے لیے سراپا سپاس ہوں. یہ ہدیہ سلیمانی نہیں سرمہء سلیمانی ہے. اس کتاب کے پڑھنے سے میرے علم میں بہت مفید اضافہ ہوا. خدائے تعالیٰ جزائے خیر دے"۔

(بحوالہ اقبال نامہ مرتبہ شیخ عطاء اللہ ص۔113)

خطبات مدراس: سید سلیمان ندوی نے اکتوبر 1925ء میں مدراس مسلم ایجوکیشنل ایسوسی ایشن کی دعوت پر مدراس کا سفر کیا اور وہاں سیرت النبی پر آٹھ خطبات دیئے جو خطبات مدراس کے نام سے چھپ کر 1926ء میں منظر عام پر آئے یہ خطبات سیرت نبوی کا جوہر ہیں۔ ان معرکہ الآرا خطبات کا سید الحق دیسنوی نے انگریزی ترجمہ prophetLiving کے نام سے کیا ہے. اور مولانا محمد ناظم ندوی نے عربی ترجمہ الرسال المحمدیہ" کے نام سے کیا ہے۔

عرب و ہند کے تعلقات: سید سلیمان ندوی نے مارچ 1929ء میں ہندوستانی اکیڈمی آلہ آباد کی دعوت پر" عرب و ہند کے تعلقات" کے موضوع پر خطبات پڑھے جن میں ہندوؤں اور مسلمانوں دونوں کو ان کا وہ عہد زریں یاد دلایا ہے. جب وہ دونوں گونا گوں اور مختلف النوع تعلقات کے رشتوں میں منسلک تھے. ان خطبات کو ہندوستانی ایکڈمی نے 1930ء میں عرب و ہند کے تعلقات کے نام سے کتابی شکل میں شائع کر دیا ہے. سید الحق دیسنوی نے اس کتاب کا بھی انگریزی میں ترجمہ کیا.

عربوں کی جہاز رانی: سید سلیمان ندوی نے مارچ 1931ء میں حکومت بمبئی کے شعبے تعلیم کی فرمائش پر انجمن اسلام ہال ممبئی میں عربوں کی جہاز رانی پر چار لکچر دیئے۔ ان میں زمانہ جاہلیت اور اسلام میں عربوں کی جہاز رانی، عربوں کی دنیا کے سمندروں سے واقفیت، ان کے بعض بحری انکشافات، عربوں کے سامان و آلات جہاز رانی اور ان کی بحر محیط کو عبور کرنے کی کوشش وغیرہ پر بحث کی گئی ہے. یہ خطبات 1935ء میں معارف پریس اعظم گڑھ میں طبع ہو کر دار المصنفین سے شائع ہوئے. ان کا بھی انگریزی ترجمہ کتابی شکل میں منظر عام پر آچکا ہے۔

خیام: سید سلیمان ندوی نے دسمبر 1930ء میں آل انڈیا اورینٹل کانفرنس کے اجلاس پٹنہ میں ایک

تحقیقی مقالہ پڑھا تھا اس کو اتنی مقبولیت حاصل ہوئی کہ کہ مولانا سید صاحب نے اس میں رباعیات کے مباحث کو بڑھا کر ایک مستقل کتاب کی شکل دے دی. یہ کتاب اکتوبر 1933ء میں شائع ہوئی۔ اس تصنیف کے مطالعے سے عمر خیام کو ایک نئے انداز سے دیکھا جا سکتا ہے۔

نقوش سلیمانی: سید سلیمان ندوی نے اردو زبان وادب اور اس کی تاریخ سے متعلق جو مضامین تحریر کیے تھے اور اردو کانفرنس میں جو معرکہ الآرا خطبے پڑھے تھے وہ سب نقوش سلیمانی کے نام سے شائع ہوئے. یہ تصنیف 1939ء کے اواخر میں شائع ہوئی. یہ تصنیف اتنی مقبول ہوئی کہ یونیورسٹیوں کے اردو نصاب میں داخل کی گئی۔

رحمت عالم: سید سلیمان ندوی نے 1940ء بچوں کے لیے آسان وسلیس زبان میں سیرت نبوی کی ایک مختصر کتاب تالیف کی. یہ تصنیف بھی اتنی مقبول ہوئی کہ ہندی اور ہندوستانی زبانوں کی مختلف زبانوں میں اس کا ترجمہ ہوا.

حیات شبلی: سید سلیمان ندوی نے اپنے شفیق استاد کی آخری وصیت کے مطابق تمام کاموں سے فارغ ہو کر مولانا شبلی نعمانی کی سوانح عمری لکھنا شروع کیا. اور دو ڈھائی سال کی مسلسل کوشش کے بعد یہ تصنیف پایہ تکمیل کو پہنچی. یہ تصنیف 1943ء میں شائع ہوئی. اور یہ 746 صفحات پر مشتمل ایک ضخیم تصنیف ہے. یہ ایک جامع اور ہمہ گیر شخصیت کی سوانح ہے اور مسلمانان ہند کے پچاس برس کے علمی ادبی سیاسی تعلیمی مذہبی اور قومی واقعات کی مستند تاریخ ہے۔

مقالات سلیمان: سید سلیمان ندوی کی وفات کے بعد دارالمصنفین نے معارف اور دوسرے رسائل میں منتشر سید صاحب کے علمی مضامین کو یکجا کر کے مقالات سلیمان کے عنوان سے شائع کرنا شروع کیا ہے.

مکتوبات سلیمان: سید صاحب کے خطوط ومکاتیب کے کء مجموعے شائع ہو چکے ہیں. سب سے پہلا مجموعہ "بریدفرنگ" کے نام سے خود سید صاحب نے مرتب کر کے 1952ء میں مکتبہ الشرق کراچی سے شائع کیا. یہ تصنیف سید صاحب کے خطوط پر شتمل ہے. جو خود سید صاحب نے 1920ء کے وفد خلافت کے سفر میں یورپ سے اپنے احباب کو ہندوستان میں لکھے تھے. دوسرا مجموعہ مکاتیب سلیمان کے نام سے 1954ء شائع ہوا. یہ مجموعہ 145 خطوط پر مشتمل ہے. جو مسعود عالم ندوی کے نام وقتاً فوقتاً سید صاحب کے مکاتیب کا تیسرا مجموعہ جو دو جلدوں پر مشتمل ہے مکتوبات سلیمانی کے نام سے شائع ہوا ہے ان مجموعوں کو عبدالماجد دریا آبادی نے مرتب کر کے علی الترتیب 1963ء اور

1967ء میں منظر عام پر لایا۔ دونوں مجموعوں میں تقریباً چار سو خطوط تاریخ وار مرتب کئے گئے ہیں۔ سید صاحب کے تینوں مجموعے علمی تاریخی اور ادبی معلومات کا بیش قیمت خزینہ اور بے حد افادیت کے حامل ہیں۔

بیسویں صدی کے اوائل میں اردو ادب کے افق پر جو ممتاز علمی و ادبی شخصیت نمودار ہوئیں ان میں مولانا سید سلیمان ندوی کو نمایاں مقام حاصل ہے آپ کی شخصیت بڑی متنوع ہے۔ تقسیم ہند کے بعد جون 1950ء میں ساری املاک ہندوستان میں چھوڑ کر پاکستان چلے اور کراچی میں مقیم ہوئے۔ وہاں بھی مذہبی و علمی مشاغل جاری رکھے۔ حکومت پاکستان کی جانب سے تعلیماتِ اسلامی بورڈ کے صدر مقرر ہوئے۔ انہتر سال کی عمر میں کراچی میں 22 نومبر 1953ء کو اس دارِ فانی سے کوچ کر گئے۔

کتابیات:

علامہ سید سلیمان ندوی بہ حیثیت مورخ۔ ڈاکٹر محمد الیاس الاعظمی

سید سلیمان ندوی کی تصانیف ایک مطالعہ۔ سید صباح الدین عبدالرحمن۔

حیات سلیمان۔ شاہ معین الدین۔

اقبال نامہ۔ شاہ عطاالله۔

☆☆☆

SHODHSAMHITA
शोधसंहिता

ISSN 2277-7067
UGC CARE Group 1

THE ROLE OF THE SANSKRIT LANGUAGE IN SUSTAINABLE DEVELOPMENT

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ABSTRACT

Sanskrit is the Linckage of tradition and modern period. Since ancient time of the India Sanskrit is scientific knowledge system .In this language this is the medium of Vedas , Literatures ,Sciences like Hydrology, Environment, Chemistry etc. .This is being the environmental language of our country. Vedic view on environment is well-defined in one verse of the Atharva Veda where three coverings of our surroundings are referred as Chhandans*i*, means coverings available everywhere. It teaches us to wisely utilize the three elements which are varied, visible and full of qualities, viz., water *(*Apah*),* Air (Vayuh*)* and plants and herbs (Vanaspatayah*).* They exist in the World *(*Prithivi) from the very beginning. It undoubtedly proves the knowledge of Vedic Seers about the basics of Environment. The concept of Sustainable Development is developed since Vedic Literature.This is humble attemt to present it.

Key Words: Sanskrit Literature, Śaśwata Vikaasa(Sustainable Development).

INTRODUCTION

Sustainable development is an organizing principle of our nature. शाश्वतं विभुः तथा विश्वस्य चिरा उन्नतिः शाश्वत प्रगतिः|In Nature, there is an inbuilt system of balancing these constituents or elements and living creatures. A disturbance in percentage of any constituent of the environment beyond certain limits disturbs the natural balance and any change in the natural balance causes lots of problems to the living creatures in the universe. All constituents of the Environment are connected with a subtle web with one another. The relation of human being with environment is very natural as he cannot live without it. From the very beginning of creation he wants to know about it for self protection and self survival. Our Vedic Philosophy which is otherwise known as Sanatan (Eternal) Darshan (Philosophy) considers Vedic Aryans are children of nature. They studied nature closely in sylvan surroundings – very minutely. The verse Ritam Badisyami, Satyam Badisyami which means I will tell about the laws of nature and I will speak the truth; is the Pramana (Proof) of their study. Ritam is defined variously by scholars in different Vedic Contexts, but in general sense it has been elaborated as great 'cosmic order' which is the cause of all motion and existence, and keeps world in order. No one can ignore it, even Devatas are abided by the Ritam – the cosmic law and they are born of Ritam. It is controlling and sustaining power acts behind all natural phenomenons. It sustains sun in the sky. It as Universal Law governs everything. The whole of the universe is working under Ritam.

➢ The Role Of Sanskrit Language In Sustainable Development

Sand-storm and cyclone, intense lightening, terrific thunderclaps, the heavy rush of rain in monsoon, the swift flood in the stream that comes down from the hills, the scorching heat of the sun, the cracking red flames of the fire, all witness to power beyond man's power. The Vedic sages felt the greatness of these forces. Therefore, they worshiped and prayed them due to regard and gratitude. They realized instinctively that action, movement, creation, change and destruction in nature are the results of forces beyond men's

ISSN 2277-7067
UGC CARE Group 1

control and thus they attributed towards divinity of nature. The laws behind all natural phenomena are constant and fresh phenomena are continually reproduced, but the principle of order remains the same; therefore, the principle existed already when the earliest phenomena appeared.

The main part of Rig Veda belongs to Natural hymns, the hymns related with natural forces. The hymns addressed to deities *(*Devatas*)* are under the influence of the most impressive phenomenon of nature and its aspects. The word Devatas means divine entities which is helpful to all without their any selfish gain. In these hymns, we find prayers for certain natural elements such as air, water, earth, sun, rain, dawn etc. The glorious brightness of the sun, the blaze of the sacrificial fire, the sweep of the rain-storm across the skies, the recurrence of the dawn, the steady currents of the winds, the violence of the tropical storm and other such natural energies, fundamental activities or aspects are glorified and personified as divinities *(*Devata*)*. The interaction with nature resulted in appreciation and prayer …but, indeed, after a good deal of observation. Attributes assigned to deities fit in their natural forms and activities, as Soma is green, fire is bright, air is fast moving and sun is dispenser of darkness. The characteristics of these forces described in the verses prove that Vedic Seers were masters of natural science.

RISHIS

The Vedic Seers have a great vision about universe. The universe consists of three interlinked webs, viz., Prithivi, Antariksha and Dyava. Prithivi, the Earth, Antariksha, the aerial or intermediate region which is between heaven and earth, and Dyava, the heaven or sky is very well established in the Vedic texts. Prithivi can be a scientific name – 'observer space'. It is our space, the space in which we live and die whatever we can see and observe. All living creatures come under the universal principle of: Asti, Jayate, Bardhate, Biparinamate, Apakshiyate, Nasyati. It means, it is there (Asti), then it takes birth *(*jayate*)*, then it grows (bardhate*),* then it starts to turn reversely (biparinamate*),* then it starts to decay *(*apakshiyate*)* and at last it decomposes *(*nasyati*)*. From one end of the universe to the other end is the expanse of Prithivi*,* and that what the name Prithivi means: the broad and extended one. Dyava can be termed as 'light space' because light propagates in this space. Antariksha can be termed as 'Intermdediate space' as this space exists in between observer space and light space. The concept of the form of the earth in *Rig* Veda is very fascinating. There is one small hymn addressed to Prithivi*,* while there are six hymns addressed to Dyava-Prithivi. Prithivi is considered the mother and Dyava is considered as Father and they form a pair together. One of the most beautiful verse of the Rig Veda says, 'Heaven is my father, brother atmosphere is my navel, and the great earth is my mother. Heaven and earth are parents: Matarah, Pitarah, Janitarah in union while separately called as father and mother. They sustain all creatures. They are great and widespread. In Atharva Veda, the earth is described in one hymns called as Bhumi Sukta or Prithivi Sukta which indicates the environmental consciousness of Vedic Rishis. The Rishi*s* appear to have advanced understanding of the earth through this hymn.

- **माता भूमिः पुत्रोs हं पृथिव्या:** (This Earth is my mother and I'm a sun of this.)
- In this Prithvi Suktam Rishi prays to Prithvi (Earth) for good wealth of world. Here our earth is sustains many plants, animals and many more energies. This is the **अक्षय्य** source of sustainable development. That is why the Sanskrit Scholar said that"
- **" अयं निजः परो वेति गणना लघु चेतसाम् |**

ISSN 2277-7067
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- **उदारचरीतानां तु वसुधैव कुटुम्बकम्||**
- (This is mine that is another this type of thinking conservative people but for broad minded people this Earth is the family)
- **अपांचैव समुद्रेकात्समुद्र इति संज्ञितः|** (The storage of water means by Samudra(Ocean)) The ocean sustains energy of weaves . This source gives Pearls , rare Plants, and Gems. This is our massive Treasure. In the Vedic Sanskrit literature Rishis prays to ocean that" **शं नो वरुणः**" (May Varuna (God of Oceans) is Propitious with us.)
- **दृशे विश्वाय सूर्यम्|(1.50.1-Soorya Suktam, Rigved) (The is for whole world)** The solar energy is the most important source of sustainable development. This is called चिरंतर उर्जा (Sustainable Energy). Solar Energy is mentioned in many Sanskrit Literatures.
- **अन्नं वै प्राणाः|(food is the breath of world).** Food is the basic need of lives. It gives life for lives.
- **पितृवत् पालयेद् वैश्वो युक्तः सर्वान् '**(60/22,23 Shantiparva, Mahabharata) As a father we have to protect world. In this context the world is like a child and it is our responsibility to protect them.
- **धूमज्योतिसलीलमरुतांसन्निपातो क्व मेघः|** (Shloka 1 ,Meghadutam) In this line Mahakavi Kalidasa says that the cloud is made by the mixer of dust ,light ,water and air. Here we can explore the science of Environment.

CONCLUSION

Sustainable Development is the proccess of nature and also world.Ancient treasures of vast knowledge reveal a full cognizance of the undesirable effects of environmental degradation, whether caused by natural factors or human activities. The protection of the environment was understood to be closely related to the protection of the dyaus or heavens and prithvi or earth. Between these two lies the atmosphere and the environment that we refer to as the paryavaran. Many of the Rig Vedic hymns therefore vividly describe the Dyava Prithvi that is, they describe Heaven and Earth together.

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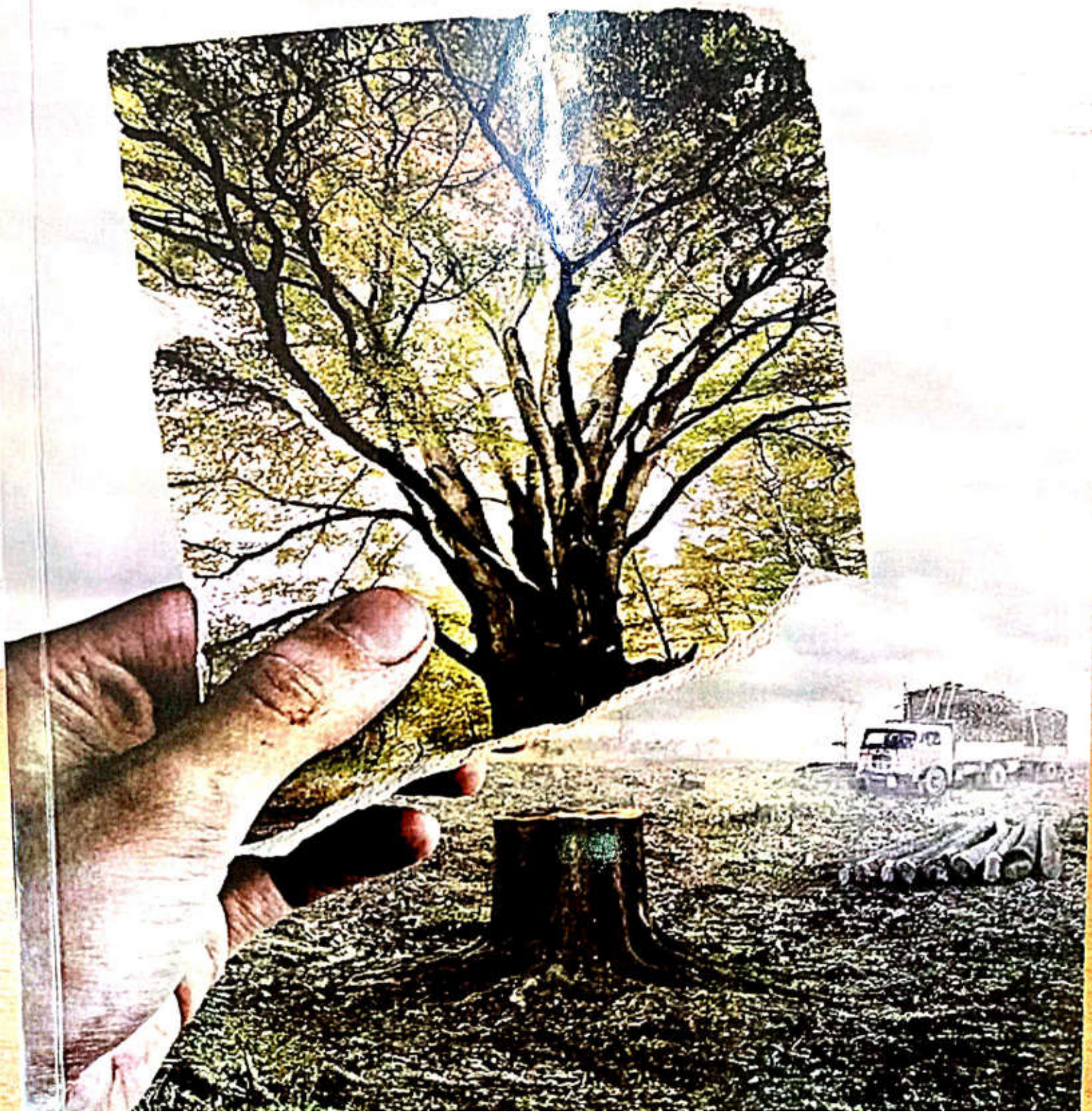
AKSHARASURYA

Peer-Reviewed, Multilingual E-Journal

ISSN: 2583-620 (ONLINE)
Volume-02, Issue 06, June 2023.



AKSHARASURYA

Peer-Reviewed, Multi Lingual E-Journal

ISSN: 2583-620X (ONLINE)

VOLUME – 02, ISSUE – 06, JUNE 2023.

PUBLISHER:

Mahesh M.

Founder Trustee and President

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ISSN: 2583-620X (Online)

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The Significance of Three Pillars in Ayurveda

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Article Link: https://aksharasurya.com/2023/06/gouramma-r-elangadi-shilpashree-k-h/

Introduction:

The real wealth in life is health. "Health is wealth" as per the saying healthy body leads to healthy mind, healthy minds work for healthy society. To maintain our physical health, it is significant to follow the healthy practices of our forefathers.Ayurvedic medical science helps us to understand the daily regimen according to persons. To get fit & healthy body one should adopt the daily routine or regimen mentioned in the Ayurvedic medical science. In Ayurveda, 'Ayu' means life 'Veda'means knowledge or science.

Ayurvedic science helps to understand the nature of our body and accordingly helps every individual to take care of their health, by adopting or practicing the same one can lead a happy and healthy life. As the saying goes, 'Prevention is better than cure' it is important to take precautionary measures

as mentioned in Ayurvedictexts and also it's critical for all to understand the primary or basic knowledge of health.

The study of Ayurvedic science stands on three pillars also known as Tridoshas i.e. Vata, Pitta and Kapha. The principles of Ayurveda deals with theseTridoshasof the body formed by the combinations of Panchamahabhutas (five basic elements) like Space, Air, Fire, Water and Earth.These *Tridoshas* are responsible for the physical and mental wellbeing of an individual.

Tridoshas:

As per Ayurveda, the definition of health is

"Samadoshasamaagnishchasamadhatumalakriyaha |
Prasannaatmendriyamanahaswasthaitiabhidiyathe||"

(Sushruthasamhita sutra sthana 15/48). It means health is the state of equilibrium of doshas, normal functioning of dhatus (body tissues) and malas (waste products of the body) along with the wellbeing of mind and unimpaired senses and cheerful soul.

Visargaadhanavikshepaii soma suryaanilatatha |
Dharayantijagatdehamkaphapittaanilatatha||

(Sushruthasamhita, sutra sthana21/8) It means the three doshas areVata,Pitta and Kapha sustain the body just as air,sun and moon support the whole world by visarga (giving away strength),adana (absorbing the energy) and vikshepa (distribution or separation) in their various dispositions. This signifies the combining forces to build up, the energy to transform and the driving force to discharge or eliminate unwanted things operatein equilibrium to promote the growth

and support the body. If this equilibrium is disturbed it leads to destruction of the body by diseases.

VATA (AIR):

The word "vata" refers to the Air.Vata comes from the phrase "vagatigandhanayo" means that which provides gati or speed is vata.It provides essential motion for all bodily processes like inspiration, expiration, helps in memory, intellect, activities etc.

Vatadosha is derived from the elements of space and air. The Vatais dry, light, cold, rough, minute, and mobile. It is located in the whole body; however its primary seats are the colon, hips, thighs, ears, bones and the skin. It is predominant in old age.It is of five types namely Prana, Udaana, Vyana, Samana and Apanavata mainly responsible for nervous function, respiration, circulation, digestion and excretion respectively. Imbalanced state of Vata leads to loss of strength, dislocation of joints, loss of complexion, discomfort, cheerlessness, sadness, thirst, pain over the entire body, roughness of the skin, stiffness of the organs, loss of sensation, tremor, perspiration, paralysis, contraction of the organs etc. To counteract vitiated Vata one should have diet and regimens that includes sweet, sour, salt, unctuous, hot properties of food, oil massage and steam.

PITTA(FIRE):

The word "Pitta" refers to the fire.Pitta comes from the phrase "tapa santapaiti" means that which produces heat & burning sensation is pitta.It provides vision perception, brings

about proper digestion, maintenance of warmth of the body, normal complexion, encourages intellect, confidence and valor.

Pitta dosha is derived from the elements of fire and water. The attributes of Pitta are slightly unctuous, hot, penetrating, light, liquid, movement & offensive odour. The primary seat of Pitta is stomach and small intestine; it can also be present in eyes, skin, blood, sweat glands. It is predominant in the middle of the life cycle, when we are young and middle aged adults. There are five types of Pitta namely Pachaka, Ranjaka, Sadhaka, Alochaka and Bhrajaka. Which are responsible for digestion, givingcolour to blood& other pigments, intellect, confidence, enthusiasm, mental faculties, vision perception complexion to the skin? Imbalanced state of Pitta leads to burning sensation in the body, feeling of heat, hyperacidity; rashes over the skin, excessive thirst, mouth ulcers, giddiness, jaundice are some of the conditions. To counteract vitiated pitta one has to prefer sweet, bitter and astringent taste of food articlesin their meals.

KAPHA (WATER):

The word "Kapha" refers to water. Kaphacomes from the phrase "shlishaalingane" means that which binds, sticks or adheres.It provides maintenance of fluid in the body, integrity of joints, stability of the body, weight gaining, vigour(vital strength) and physical strength.

The primary seat of Kapha is chest, it also located in throat, head, larynx, smaller joints, stomach, plasma, nose, tongue. It is predominant in childhood age. *Kaphadosha* is derived from the elements of the earth and water. The attributes of Kapha are unctuous, viscosity, cold, heavy, slow, smooth,

sliminess, stable. There are 5 types of Kapha namelyAvalambaka, Kledaka, Bodhaka, Tarpaka and Shleshaka. This nourishes the lungs and heart, helps indigestion, esponsible for perception of taste, nourishes the sense organs and lubricates the joints. Imbalanced state of Kapha leads to drowsiness, excessive sleep, indigestion, inactivity, goiter, obesity etc. To bring down the imbalanced state of Kapha, diet consists of pungent, bitter and astringent taste. Physical exercise, dry powder massage is beneficial.

Different stages of life correspond to different stages of doshas:

It is fascinating how children are unfailingly happy all the time,Ayurveda says that by virtue of age, Kapha is predominant in childhood,Pitta gains supremacy in youth and as we age Vata reigns supreme and results in the natural emaciation of the body. By this very wonderful concept it can be understood that intelligence,patience and stable mindedness, which are natural attributes of Kapha, tend to decrease as we grow up and aggression,determination,anger tend to increase in the youth which then results in fear,anxiety,impatience and intolerance in old age.

Conclusion:

For life to sustain its rhythmic existence at a state of normalcy,these three forces or doshas should so operate as they may result in a state of equilibrium implying the state of health. Slight deviation from this equilibrium with scope for return to its normalcy may lead to illness or disease, but extreme or drastic deviation from this equilibrium with no scope for return to its normalcy may lead to death. To summarize the above,

understanding the disease from Vata, Pitta, Kapha and applying the principle of Vata Pitta Kapha treatments respectively will definitely help the patients. Tridoshas plays a vital role in diagnosing the diseases, management of diseases and helps in adopting respective vata pitta kapha related diet and regimen.

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The Role of Marine Algae as a Bioindicator in Assessing Environmental Pollution

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Abstract:
The potential ecological effects of rising levels of heavy metal concentrations in the aquatic environment are of great concern caused by their highly bio-accumulative nature and higher toxicity, which leads to the destroy of several habitats for marine organisms. The purpose of this research are presented analyses, for both the concentration of heavy metals in marine water and algae tissue, in an effort to gain some insight into the level of metal contamination which might exist in the coastal marine environment along the Libya beaches. Assessed by measuring pollution indicating parameters of marine water (TC^{O}, S ‰, pH, Do), and concentration of heavy metals. This study also determined indices of pollution as a bioaccumulation factor (BAF) and metal pollution index (MPI), from six different sites in two seasons (Spring and summer), 2016. The results indicate the slightly higher level of temperature and pH on the summer season, while salinity and dissolved oxygen were slightly higher level in spring. A Positive correlation was found between dissolved oxygen and salinity (r^2= 0.897*) and, a negative correlation was found between other parameters. The results show that there is a statistically significant difference in averages of concentration of (Pb), (Mn) and (Zn) between algae species and stations overall. The highest concentration of (Pb) was recorded in the *Enteromorpha sp.*, 1.228 µg g^{-1}. The highest concentration of (Mn) was recorded in the *U. lactuca, Corallina sp.*, and *Chaetomorpha sp.* The present study recorded higher concentrations of Zinc (Zn) 0.867 µg g^{-1}, in the *Enteromorpha sp.*, and *Laurencia sp.* 0.861 µg g^{-1}. In general, Cadmium recorded low values irrespective of sites and algal species. The region of S6(Libya station) can be identified as a place with higher Pb and Zn contents while the region of S1(Libya harbor), shows higher contents of Mn. As well the region of S2(Libya company), shows higher contents of Cd. The metals concentrations recorded for the different tissues and sites of the present study confirm the occurrence of significant seasonal variability, with maximum concentrations usually observed in summer. The data demonstrate a positive correlation between all the metals, except the negative correlation between Zn and Mn. The concentration of the metals in seawater in the six sampling sites followed the order of Mn>Zn>Pb>Cd. A somewhat, BAF of the different heavy metals showed a common pattern of peaking at S2(Libya company), with moderate reduction at S6 (Libya station), S3(Libya station), S4(Libya station) and S1(Libya harbor), and a relatively greater reduction at S5(Libya station). The ability to accumulate heavy metals MPI was highest in *Laurencia sp.*, which was substantially higher than those of the accompanying species at all species at all stations. The present study emphasizes of control of pollutants such as sewage and industrial effluent discharges into the marine environment without treatment.

Keywords: Marine algae, Bioindicator, Environmental Pollution, bioaccumulation factor, metal pollution index

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Recent trends in degradation of microplastics in the environment: A state-of-the-art review

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ARTICLE INFO

Keywords:
Microplastics
AOPs
Photodegradation
Photocatalysis
Electrochemical degradation
Biodegradation

ABSTRACT

Microplastics (MPs) have become a global environmental concern due to their considerable harm to the environment and humans. However, only a few researches have been published on the total removal of MPs from the environment. Traditional treatment procedures were unsuitable for MPs due to secondary pollutant development and toxicity concerns. As a result, several strategies for treating MPs have been investigated in recent years. This review covered recently developed MPs degradation strategies, such as abiotic and biotic, as well as the relevant degradation mechanisms and the present state of advancement. Every method has its own set of limits, advantages, and disadvantages. As a result, each technique's strengths and constraints have been thoroughly examined. Some recommendations for potential research directions have been provided based on the gaps in information in the analyzed 109 published research publications, such as the lack of standardized methodologies for evaluating and quantifying the degradation process, degradation pathway analysis, and field application. This review's goal is to give an in-depth account of the different MPs' disintegration processes, along with a summary of each one's advantages and disadvantages and limitations.

Introduction

Plastic materials have provided considerable comfort and ease to our everyday life owing to their low weight, good chemical stability, remarkable durability, and competitive prices (Lastovina and Budnyk, 2021). According to reports, up to 368 million tonnes of plastic items were manufactured yearly in 2019, with output expected to reach 500 million tonnes by 2025 (Bai et al., 2019; Huang et al., 2021a). Only a small percentage of plastics are recycled, and the vast majority are subsequently released to the ecosystem as waste plastic via multiple mediums. Plastics are considered non-biodegradable because, depending on the type, they can persist in an aquatic environment for many years without breaking down (Wong et al., 2020).

Microplastics (MPs), or traces of plastic with a particle size of less than 5 mm (Ryberg et al., 2019), are proving a developing matter of concern due to their harmful impacts on the biosphere, notably in the ocean. As per recent research, MPs are found not just in oceans (Rodrigues et al., 2018) but also in sediments (Wang et al., 2018), rivers (Tiwari et al., 2019), wastewater (Patchaiyappan et al., 2020), the airspace (Geng et al., 2021), and soil. MPs can be consumed by a variety of marine animals, including fish, zooplankton, phytoplankton, and seabirds, and concentrate in their tissues and circulatory systems, causing negative effects (Zhu et al., 2019). They have also been detected in arctic glaciers and deep-sea deposits (Kumar et al., 2021). MPs easily permeate the human body through the food web due to their huge amount and tiny size. As a result, MPs constituted a significantly greater risk to humans than large plastics (Gavlarde et al., 2021). MPs have been investigated in various research papers to cause extensive damage to organisms' life processes and mortality. As a result, MP pollution has gained global attention as an emerging environmental concern.

Microplastic degradation corresponds to the key concepts of the circular economy by terminating the cycle of plastic waste. Microplastics can be effectively degraded into useful products or feedstocks to manufacture new plastics, minimizing the need for virgin materialsand fostering an improved lifespan. MPs are easily consumed by creatures such as birds, tortoises, and other aquatic species owing to the minute size of particles, leading to organ damage (Du et al., 2021). The use of conventional procedures can help to reduce the production of MPs, and burying waste plastics in landfills prevents them from leaking into the surrounding environment (Zhang et al., 2021). However, because of their resistive characteristics, dumped plastic wastes remain in the same position for prolonged periods of time, occupying a large amount of land

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https://doi.org/10.1016/j.hazadv.2023.100343
Received 11 March 2023; Received in revised form 4 July 2023; Accepted 9 July 2023
Available online 16 July 2023