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PRINCIPAL
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Principal





Using chemical bath deposition to create nanosheet-like CuO electrodes for supercapacitor applications

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ABSTRACT

We report the effect of ionic liquids on chemically synthesized hierarchical-like copper oxide (CuO) thin films for supercapacitor applications. Concisely, the CuO thin films were deposited via chemical bath deposition (CBD) using 2-dimethylimidazolium chloride [HPDMIM(C1)], 1-(2',3'-dihydroxypropyl)-3-methylimidazolium chloride [DHPMIM(C1)], and *N*-(3-methyl-2-oxopropyl)pyridine chloride [MOCPP(C1)] ionic liquid solvents. The effects of the ionic liquid solvents on the morphological evolution of the as-prepared films were analyzed, and electrochemical properties were investigated. The highest specific capacitance was achieved for the electrode with a nanosheet-like structure produced by functionalization with the HPDMIM(C1) ionic liquid. The maximum specific capacitance achieved for the HPDMIM(C1):CuO hybrid electrode was 464 F g^{-1} at 5 mV s^{-1} in a $1 \text{ M Na}_2\text{SO}_4$ electrolyte. Thus, our findings, in addition to the stability of the HPDMIM(C1):CuO, indicate that it is a candidate for energy-storage applications.

1. Introduction

Increasing worldwide energy demand has played a catalytic role in the advancement of several energy storage technologies [1]. Two of the most important factors in energy storage research is renewability and sustainability [1–4]. Many researchers are currently focusing on addressing problems regarding energy storage technologies such as batteries and supercapacitors [4–9]. The main motivation in the case of supercapacitors is to improve their performance because these devices can supply very high power compared with batteries and other electronic devices [1–6]. Supercapacitors are distributed into three core types: electrochemical-double-layer capacitors, pseudocapacitors, and hybrid capacitors [1,5–9]. All three supercapacitor types have high charge–discharge rates, high power densities, long lifecycles, and safe operating processes [2,2,3,4].

Copper oxides are useful in various applications involving heterogeneous catalysis [5–9], gas sensing [10], photoelectrochemical cells

[11], and supercapacitors [12]. They have been extensively investigated as an electrochemical material for supercapacitors because of their high abundance in the earth's crust, low cost, low toxicity, and good charge transport properties, all of which are beneficial in supercapacitor applications. The copper oxide are two common phases like copper (II) oxide (CuO) and copper (I) oxide (Cu₂O) [13–15]. Different CuO nanostructures have been prepared and applied in supercapacitors, including flower [16,17] and nanoflakes [18], willow-leaves [19], micro-roses and micro-wool [20], nanosheets [21,22], nanospheres [23], nanoplatelets [24], nanowires [25], nanoribbons and nanoflowers [26], dandelion-like CuO microspheres [27], and nanorods [28].

Several methods have been used to prepare CuO and Cu₂O electrodes for supercapacitors [29–35]. Ghasemi et al. [36] reported using electrodeposited Cu₂O–Cu(OH)₂ nanoparticles as a supercapacitor electrode material. They attained a specific capacitance 425 F g^{-1} in $0.5 \text{ M Na}_2\text{SO}_4$ electrolyte. Li et al. [37] synthesized CuO thin films and its different nanostructures using thermal method. He reported a

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Availability of Water Resources in the Indapur Tahsil, Pune District

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Abstract

The average annual rainfall is 550 mm. Owing to lack of rainfall there is a need of restoring and maintaining water. In Indapur tahsil, out of 142 villages, around 73 villages (51% area of the total area) gets the benefit of Ujani Dam, Bhima river, Nira river, Nira Left canal and Khadakwasala right canal. The remaining 71 villages (49 % area of the total area) depend on uneven rainfall. All these villages fall under the drought-prone area. The middle part of Indapur tahsil is the most water scarcity area. The majority of small and marginal farmer and landless depends on agriculture, especially in the dry area. Primary and secondary data are used in this paper and data process through Arc View 9.3, Surfer version 10, Global Mapper version 11 for this paper.

The availability of fresh water for domestic use, agriculture purpose and industrial purpose water conservation and management is necessary. Water resources are available through canal, reservoir, K.T. weirs, farm tanks, tanks and other sources in the study area. From all reservoir types water is made available for Indapur tahsil and around 273.81MCM.

The major amount of availability of water resources is rainfall and existing conservation measures. It is observed that the wells and canals are major source of water supply in the study area.

KEYWORDS: availability, domestic, agriculture, industrial, reservoir, water scarcity.

Introduction

Water is the basic need of life for the human beings and any alteration in its availability is directly going to impact them through various means. Most of the rivers are rain-fed and seasonal and only few are perennial. The present study has been taken up to quantify the area being in monsoon climatic conditions it is subject to high variability conditions, it's likely to affect on the availability of water. Thus the conservation and optimum utilization of water as scarce resource is extremely important for national economic development. Verma and Phansalkar (2007) studied the temporal and spatial variation in availability of water and it was observed that 71 percent of India's water resources are available to only 36 percent area while the remaining 64 per cent has 29 percent available. Till the middle of the 20th century, the importance of water on life had not been particularly felt because of its moderate demand. But relentless increase in the demand of fresh water in recent years has lead to the scarcity of this basic resource in country.

In Indapur tahsil, out of 142 villages, around 51% area of the total area gets the benefit of different natural and manmade sources. The remaining 49 % areas of the total area depend on uneven rainfall. Water use includes all individual and collective activities of human society which affect water resources and change their quality and quantity. The method of water use and distribution depends especially on the degree of development and availability of water. It becomes systematic as a consequence of agricultural, social and industrial development. Water is also an

Rainfall Distribution and Its Variation in the Indapur Tahsil District Pune Maharashtra

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Abstract: Indapur tahsil is one of the drought-prone areas in Pune district. It is always known as a region of scarce rainfall in Maharashtra. The study area comes under the rain-shadow region, due to which it is considered as a drought-prone area. The average annual rainfall is 503.8 mm. The onset of monsoon, amount of rainfall and the variability of rain are very irregular in the study area. As such, a large part of agricultural land depends on the monsoon and there is an uncertainty of rainfall. The majority of small and marginal farmer and landless depends on agriculture, especially in the dry area. The present research work secondary data sources are used. In addition to this detail, spread of average annual rainfall which has been analysed for more than 90 years of data has also been considered for interpretation. All the supported data is collected from different offices and online. There are seven watershed areas in the study area. Average rainfall distribution spread over the entire study area thus produced in grid format has been used for volumetric analysis. The average annual volume of rainfall is 1052.46 MCM. The very low rainfall volume is observed to the northern side and very high rainfall volume is observed to the eastern side of Indapur tahsil.

Key words: distribution, rainfall, variation, watershed.

1. Introduction:

Investigations of Rao and Mishra (1971) have shown that annual rainfall of India is quite stable in general, but it is most uncertain in the north-western parts of the country. Currently, the main problem emerging in many parts of the world is water scarcity. The Indapur tahsil being a semi arid and arid track incorporated under the Drought Prone Area Programme (DPAP) the area is characterized by scanty and uneven rainfall ranges from 450 to 550 mm.. The Rainfall is mainly received from the south-west monsoon. Monsoon sets in the month of June and lasts up to the month of October. Monsoon onsets first week of June and having its peak period during the month of September and October. It is also characterizes by uneven and scanty rain with long dry spell during summer. The highest rainfall is observed in the in 2009 and it is recorded to be 1103 mm at Bawada and minimum at Sansar 85 mm in 2003. Agro climatically, this study area belongs to scarcity zone of rainfall to about 80 to 90 percent received from southwest monsoon and remaining very less rainfall receives from retreat of monsoon. It can be clearly noticed that rainfall distribution decreases steadily from north-west to south-east direction. The study area comes under the rain shadow region, hence rainfall is very irregular. The onset of monsoon, amount of rainfall and the variability of rain are very irregular in the study area.

2. Objectives

- To understand rainfall condition.
- To study the variation of the rainfall.
- To analyze the rainfall distribution in the study area.

3. Study area

Indapur tahsil is one of the tahsils in the Pune district consisting of 142 villages along with one urban centre in the study area. There are eight revenue circles in the tahsil. The area extends from 17° 53' 42" to 18° 19' 58" North latitudes and 74° 39' 16" to 75° 09' 39" East longitudes (**Fig. 1**). The area is drained by the river Bhima on north and east both sides. Nira River flows south of Indapur tahsil. Total geographical area of the tahsil is 1575.38km² (Census 2011), out of which Nira river



Flower-like $\text{NiCo}_2\text{O}_4/\text{NiCo}_2\text{S}_4$ electrodes on Ni mesh for higher supercapacitor applications

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ABSTRACT

In this research, we have effectively synthesized a novel $\text{NiCo}_2\text{O}_4/\text{NiCo}_2\text{S}_4$ powder by co-precipitation and thin films prepared using a screen-printing method on Ni mesh for supercapacitor applications. Herein, we report the effect of unique hierarchical nanostructures and the systematic effect of Ni and Co on the structural, morphological and electrical properties of the $\text{NiCo}_2\text{O}_4/\text{NiCo}_2\text{S}_4$ electrodes. The optimized $\text{NiCo}_2\text{O}_4/\text{NiCo}_2\text{S}_4$ electrode shows outstanding performance with a specific capacitance of 1966 F g^{-1} at 5 mV s^{-1} . The cycling stability reports indicate the $\text{NiCo}_2\text{O}_4/\text{NiCo}_2\text{S}_4$ electrodes have an outstanding cyclic stability with 91% capacity retention. From the supercapacitor performance results, we confirmed that the $\text{NiCo}_2\text{O}_4/\text{NiCo}_2\text{S}_4$ electrode is useful for the fabrication of symmetric supercapacitors. These results reveal that the $\text{NiCo}_2\text{O}_4/\text{NiCo}_2\text{S}_4$ electrodes is a capable electrode material for supercapacitor applications in the future.

1. Introduction

In recent years, with the growth of the world economy, society has demanded electrical energy storage devices with high power and energy densities for use with alternative energy sources [1]. In recent years, many electrical energy storage devices are available in the market. Out of these, supercapacitors receive great consideration due to their low-cost, high power and energy densities [1,2], excellent stability [3], and fast charge-discharge compared to lithium-ion batteries and traditional capacitors [4]. Anodic and cathodic materials play an important role in the storage of electrical energy in supercapacitors [1–5]. However, the main problem in commercial device fabrication is lower power and energy density in supercapacitors [5]. Specific capacitance and cycling performance of supercapacitors can be enhanced by changing working materials. This is an important factor, which is beneficial for commercial applications of supercapacitors [6]. The main key is developing new strategies to improve energy storage with higher specific capacitance and long cyclic stability [7].

Currently, binary and ternary transition metal oxides are used for higher theoretical and experimental specific capacitance, which are very useful for portable electronic device fabrication [8]. However, transition metal oxides have comparatively lower electrical conductivity and low cyclic stability [9]. To avoid these problems, we apply a new strategy to design new nanostructure composite materials that have higher electrical conductivity and device performance [10,11]. Binary and ternary metal sulfides, like NiS, CoS and NiCo_2S_4 , demonstrate better performance in various fields, such as oxygen evolution reactions [12], supercapacitors [13], water splitting [14], photocatalytic hydrogen evolution [15], and dye-sensitized solar cells [16], etc., than other oxides and hydroxides, for example NiO, CoO, $\text{Co}(\text{OH})_2$, $\text{Ni}(\text{OH})_2$, $\text{MnCo}_2\text{O}_4/\text{CoCo}_2\text{O}_4$, $\text{Mn:Co}_3\text{O}_4$, and ZnCo_2O_4 thin films [17–19]. Out of these ternary transition metal sulfides, NiCo_2S_4 and NiCo_2O_4 electrodes are better for supercapacitor application, because they provide higher electrical conductivity, high surface area, have excellent capacitive properties, and are environmentally stable [20–22].

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Study and Analysis of Water Resources in Indapur Taluka (Pune District)

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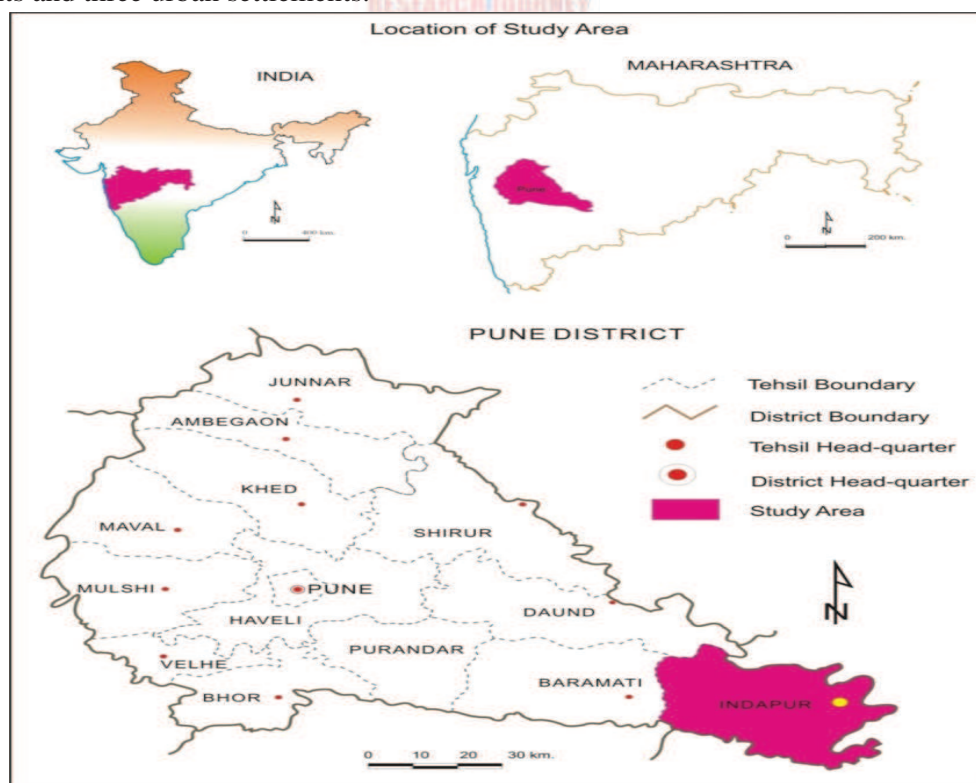
1. Introduction

Water is vital to life, without which no living body can survive. Water is considered as prime natural resource, a basic human need and a valuable national asset. Water is core component of environment. There is vast disparity in the distribution and utilization of water resource at the global, regional and local levels. Water scarcity due to depletion of surface as well as ground water following fast population growth, urbanization, rising incomes, industrial development etc. For water management, we need to assess the water resources.

The main problem is that water source is abundant in the part of east and south of Indapur taluka, whereas water sources is scanty in west and north side of Indapur taluka. So we have studied the water resources in Indapur taluka.

2. Study Area

Indapur tahsil is situated in Pune district. The northern and eastern border is demarcated by Bhima river in Pune and Solapur districts while southern boundary is confined by Nira River in Pune and Satara and Solapur districts. The west boundary is confined by Baramati and north boundary is delimited by Daund tahsil of Pune district. The region extends between $17^{\circ} 53'$ to $18^{\circ} 15'$ north latitudes and $74^{\circ} 35'$ to $75^{\circ} 8'$ east longitudes. The total geographical area of this tahsil is 1552.93 square kilometres having 3, 83,183 population (2011). This tahsil consists of 142 settlements and three urban settlements.





Short communication

Effect of deposition parameters on spray pyrolysis synthesized CuO nanoparticle thin films for higher supercapacitor performance

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ABSTRACT

In this study, copper oxide (CuO) thin films were synthesized at different deposition temperatures on fluorine doped tin oxide coated glass (FTO) substrates by spray pyrolysis for supercapacitor applications. The physical and electrochemical properties of the as-synthesized CuO samples were characterized via different analytical techniques such as X-ray diffraction (XRD), X-ray photoelectron spectroscopy, scanning electron (SEM) microscopy, surface wettability tests, and electrochemical measurements. The results showed that the deposition temperature affected their structural, morphological, and supercapacitor properties. The higher specific capacitance and extensive charge/discharge capability of the nanoparticle-like CuO thin films demonstrated their suitability as outstanding candidates in electrochemical applications. The evaluated specific capacitance further confirmed the effect of the deposition temperature on the supercapacitor performance of the CuO electrodes; its values for the thin films synthesized at 300, 350, and 400 °C were 363, 691, and 487 F g⁻¹, respectively, at a scan rate of 5 mV s⁻¹ in a 2 M Na₂SO₄ aqueous electrolyte. Hence, this study demonstrates that the surface morphology and electrochemical supercapacitive properties of materials are dependent on the deposition temperature of CuO thin films.

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1. Introduction

The world is currently demanding for new energy storage/conversion devices that are lightweight, eco-friendly, and inexpensive. Various types of such devices including capacitors [1], batteries [2], fuel cells [3,4], solar cells [5], and supercapacitors are available commercially [6–8]; among them, supercapacitors are better than capacitors and batteries because of properties such as their high energy and power densities [7–10], fast charging/discharging, and long-term cycling stability [11,12]. These properties are useful in various applications, including in portable media players, digital electronics and cameras, medical devices, railways, street lights, and power banks [9–13]. Supercapacitors can be classified as EDLCs and pseudocapacitors based on their charge storage mechanism [7, 10–15]. This mechanism is related to non-faradaic capacitance resulting from the ion transformation in the Helmholtz double layer between the electrode and electrolyte in the former

[11,13–19] and to faradaic reactions involving electrostatic charge storage in the latter [20,21].

Researchers have been investigating various metal oxide materials such as ruthenium oxide, iron oxide, manganese dioxide, nickel oxide, and copper oxide as well as conducting polymers for use in supercapacitors [8–13,20,21]. Among them, ruthenium oxide has exhibited high specific capacitive, high power density, and good stability, but its commercial distribution is hindered by its higher cost and environmental impact compared to those of other binary metal oxides. Dubal et al. [22] synthesized CuO via chemical bath deposition (CBD), reporting three different nanostructures that affected the supercapacitor performance; they attained a higher specific capacitance of 346 F g⁻¹ with microwoolen-like CuO nanosheets at a scan rate of 5 mV s⁻¹. Sagu et al. [23] deposited CuO thin films as photoactive materials on FTO-coated glass substrates using electrodeposition, and measured a highest photocurrent density of 2.1 mA cm⁻² in a 1 M NaOH electrolyte. Shu et al. [24] fabricated CuO thin films on a Cu foam by electrochemical anodization; they observed single-phase copper oxide with good electrochemical properties and a specific capacitance of around 600 mF cm⁻² in a 2 M KOH aqueous electrolyte at a current density of 1 mA cm⁻² and excellent cycling stability with around 94% retention

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कलम ३७० निर्मिती व प्रवास

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भारताला स्वातंत्र्य मिळून सात दशके पूर्ण झाली स्वातंत्र्य मिळाल्यापासून आजपर्यंत आपण अनेक समस्यांशी झगडत आहोत. त्यातील प्रमुख समस्या म्हणजे काश्मीर आणि कलम ३७० ही होय. एकंदरीत भारताच्या घटनात्मक आणि राजकीय प्रक्रियेला दीर्घकाळ प्रभावीत करणारे सर्वात वादग्रस्त व चर्चेचा विषय ठरलेले कलम म्हणजे ३७० होय. कलम ३७० हे काश्मीरच्या वेगळेपणाचे (काश्मीरीयतचे) एक प्रतिक मानले गेले, त्यामुळे ते अधिकच अडचणीचे ठरले. सर्वसाधारणपणे ३७० कलमाबाबत दोन टोकाचे दृष्टीकोन पहायला मिळतात. एक म्हणजे कलम ३७० रद्द केलेच जाऊ शकत नाही अशी भावना व समज आणि दुसरे म्हणजे कलम ३७० रद्द करणे हाच काश्मीर समस्येवरील एकमेव रामबाण उपाय आहे. मात्र ३७० कलम हा मुद्दा वाटतो त्यापेक्षा अधिक राजकीय व भावनिक आहे. तो तसा भावनिक व राजकीय का झाला हे समजून घ्यायचे असेल तर कलम ३७० ची निर्मिती कशी झाली? कलम ३७० कोणत्या तरतुदीमुळे विशेष ठरते? कलम ३७०चा प्रवास? कलम ३७० रद्द करण्यामुळे काय बदल होणार? कलम ३७० रद्द केल्यानंतरचे धोके काय? इ. प्रश्न समजून घेणे गरजेचे आहे. प्रस्तुत संशोधन लेखामध्ये या प्रश्नांचा शोध घेण्याच्या दृष्टीने प्रयत्न करण्यात आलेला आहे.

कलम ३७० ची निर्मिती

घटना समितीचे एक सदस्य एन.गोपालस्वामी अयंगर यांनी १७ ऑक्टोबर १९४९ रोजी घटनासमिती मध्ये ३०६ (अ) (आत्ताचे कलम ३७०) सादर केले या कलमावर फारशी चर्चा न होता त्याच दिवशी ते मान्यही करण्यात आले. या कलमानुसार जम्मू - काश्मीर राज्याला इतर संस्थानापेक्षा वेगळी वागणूक देण्याचे कारण अयंगर यांनी स्पष्ट केले ते पुढीलप्रमाणे.

- १) काश्मीर राज्यातील सांस्कृतिक -सामाजिक परिस्थिती भिन्न आहे त्यामुळे ती तात्काळ भारताशी एकात्म होण्यासारखी नाही. कालांतराने असे एकात्मीकरण होईल.
- २) काश्मीरमध्ये सध्या अंतर्गत अशांतता आहे तसेच हा प्रश्न संयुक्त राष्ट्राकडे आहे. त्यावर लागलीच तोडगा निघण्याची चिन्हे नाहीत.
- ३) काश्मीरमध्ये शांतता प्रस्थापित झाल्यानंतर तेथे सार्वमत घेऊन लोकेच्छेचा आदर करण्यास भारताने बांधिलकी मानली आहे.

कलम ३७० मधील तरतुदी

भारतीय संविधानाच्या पहिल्याच कलमात काश्मीरला भारताचे १५ वे राज्य म्हणण्यात आले. परंतु त्याची तत्कालीन पार्श्वभूमी लक्षात घेऊन संविधानात कलम ३७० चा अंतर्भाव करण्यात आला होता. ज्यात तात्पुरती, संक्रमणात्मक व विशेष प्रावधाने अंतर्भूत होती यात.



Variation in chemical bath pH and the corresponding precursor concentration for optimizing the optical, structural and morphological properties of ZnO thin films

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Abstract

In the present study, ZnO thin films were deposited by chemical bath deposition carried out by selective correlation of varying (i) pH values at fixed concentration and (ii) concentration of the precursors at fixed pH. The selective correlations were done by using the characterization tools like X-ray diffraction, scanning electron microscopy, transmittance, refractive index, dielectric constant, Fourier-transform infrared spectroscopy and IV measurements. Transmittance was found to increase from 57 to 87% on varying the pH from basic side (10.8) to acidic side (pH 6.8) with a blue shift in band gap. The nature and morphology of the deposited films were found to be dependent on pH as well as concentration. Acidic pH 5.0 was found to be most suitable for deposition of highly transparent film with low absorption coefficient, refractive index and dielectric constant. On the other hand, nearly complete coverage of the substrate and high purity was observed in the ZnO thin films which was deposited by taking equal 100 mM concentration of Zn(NO₃) and HMTA precursors at a fixed pH 5.0 as desired, sheet resistance was also found to increase on the acidic pH side which is useful in case of buffer layer solar cell application. These studies lay a foundation stone for understanding the optical and morphological parameters by selectively correlating the pH and concentration variation at the same time.

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1 Introduction

Zinc oxide (ZnO) is a wide bandgap semiconducting material with unique chemical, optical and electrical properties. It has attracted considerable attention due to its various applications such as gas sensor [1], solar cell materials [2], antimicrobial materials [3, 4], optoelectronics devices [5, 6] and several other important applications [7]. These films are widely used as conductive and optical cover layers of large area solar cells [8, 9]. Different methodologies have been reported by several groups for deposition of ZnO nanostructures [10, 11]. Wet chemical techniques [12], physical vapor deposition [13], metal organic chemical vapor deposition (MOCVD) [14], pulsed laser deposition [15], molecular beam epitaxy (MBE) [16], sputtering [17], electrospinning [18] etc. are few common techniques. Most of these techniques are performed at high temperature and require expensive instrumentation. Wet chemical methods are comparatively simple, less expensive and reliable method.

Chemical bath deposition (CBD) is a low temperature wet chemical technique being widely used for the deposition of ZnO thin film buffer layers [19, 20]. It is a simple technique,

Kinetic Study of Fast Brominations of Xylidine Using Competition Techniques

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Abstract: The competitive kinetics applied with assurance and determine the kinetic in milliseconds due to fast bromination reaction. Determination of kinetics is fundamental aspects for the design and operation of the reactor. Competition kinetic method was proposed to determine directly bromination rate constant of regioisomers of Xylidine. The specific reaction rates determined from this study are $1.7 \times 10^5 \text{M}^{-1}\text{S}^{-1}$ for 3,5 Xylidine, $1.4 \times 10^5 \text{M}^{-1}\text{S}^{-1}$ for 2,5 Xylidine and $1.2 \times 10^5 \text{M}^{-1}\text{S}^{-1}$ for 2,3 Xylidine. Kinetic evidence gives information about mechanistic route.

Keywords: Regioisomers of Xylidine, Competitive kinetics, Bromine, Potassium nitrate, potassium iodide

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I. Introduction

Kinetics of chemical reaction deals with the rate of chemical reaction, Chemical reaction is one or two step process usually involve collision between two reactants refer to as a bimolecular step or dissociation of a single reactant molecule which is refer as unimolecular. Kinetics study of chemical reaction is carried out analysis of elementary steps i.e. the reaction mechanism and determination of absolute rate of reaction. The rate of chemical reaction means the rate at which reactants are used up or equivalently the rate at which products are formed, In kinetic studies the kinetic parameters such as frequency factor, activation energy, stiochiometric concentration, enthalpy and entropic changes on the rate of reaction¹

Experimental techniques have been developed to monitor reactions over timescale varying as few femto seconds ($1\text{Fs} = 10^{-15}\text{sec.}$) It is to monitor the kinetic study of a slow reaction occurring over minute to hour or longer and kinetic study of a fast reaction occur in few seconds or femto seconds therefore highly specialized techniques are used to study fastest reaction. In 2003, more than twenty US Army troops were allegedly exposed to 3,4-xylidine during the operation of Iraq, leading to a number of health complaints.²

A kinetic experiment essentially consists of mixing the reactants and initiating reaction on a timescale that is negligible to that of reaction and then monitoring concentration of reactants and products as the function of time. Reaction in pharmaceutical industries is known for their complexities, reaction with intermediate product are common in these industries.³ For kinetic study of a fast reaction a large number of techniques have been developed as Flow Techniques, Flash photolysis techniques, Relaxation Method, Life time methods, Absorption Spectroscopy, Competition Techniques. The competition techniques are necessitated to study the kinetics of these brominations of aromatic substrate due to their rapidity.

Competition Techniques-

In Competitive Techniques A and B react with C However A and B do not react with each other but competition take place with A and B react with C Where C is insufficient quantity although A and B are large amount, if the rate constant for one of the competitive reaction is known, the other can be determined.

II. Experimental Method:

The Competition ratio V-v/v is maintained to be near to unity In titration v Cm^3 of sodium thiosulphate in the iodometric titration corresponds to the bromine reacted with potassium iodide V-v is corresponds to that reacted Xylidine in the competition. The Competition ratio V-v/v is arranged as that of near about 1. By using the following equation K can be calculated



Mechanistic study of colorimetric and absorbance sensor developed for trivalent yttrium (Y^{3+}) using chlortetracycline-functionalized silver nanoparticles

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ABSTRACT

The presence of hazardous, radioactive, and rare earth metal such as yttrium (Y^{3+}) in water poses a serious health concern to the public health, thus, exploring novel Y^{3+} -binding molecules and colorimetric indicators are desired. Chlortetracycline (CTC)-functionalized silver nanoparticles (AgNPs-CTC) were synthesized, purified by centrifugation and then characterized by UV-vis spectroscopy, XPS, XRD, and HR-TEM. Functionalization of AgNPs with CTC molecules enabled the rapid and sensitive detection of trivalent yttrium ion (Y^{3+}). A decrease in the intensity of the original surface plasmon resonance peak at 420 nm was observed within the fraction of a min, with the simultaneous appearance of a new peak at a longer wavelength (540 nm); thus, a novel colorimetric and ratiometric absorbance probe was achieved. The free-O-containing moieties of CTC on the AgNPs surface coordinate with Y^{3+} . Thus, CTC molecules led to the bridging of the AgNPs and subsequent aggregation. A good linear relationship ($R^2 = 0.933$) in the range of 18 to 243 nM for Y^{3+} was observed, and the limit of detection (LOD) for ratiometric results was approximately 57.7 nM. The AgNPs-CTC sensor exhibited better colorimetric performance in terms of excellent sensitivity, LOD, and rapid formation of the AgNPs-CTC complex towards Y^{3+} . The Y^{3+} spiked water samples from different sources and fetal bovine serum suggest that the developed method is practically useful and essentially portable for on-site monitoring. The AgNPs-CTC sensor can be also applied as a common colorimetric indicator for the detection of trace levels of Y^{3+} and lanthanides.

1. Introduction

Facile detection of metal ions is of interest with high sensitivity, basically in aqueous media, is an important research area. Over the past several decades, research into the applications and biological significance of yttrium-compound based biomedical products has increased dramatically [1,2]. It is one of the important radioisotopes frequently released from radioactive waste into the environment [3]. Yttrium (Y^{3+}) are quite hazardous and non-biodegradable; thus, they must be detected and safely removed from polluted streams. Similarly, increased use of lanthanides in catalysis, fertilizer, and medical diagnosis, it has raised serious concerns over their potential in pollution and deserves new methods detection of trace levels [4]. Traditional methods such as inductively coupled plasma atomic emission spectrometry [5], and inductively coupled plasma mass spectrometry (ICP-MS) [6] have

typically been used to detect Y^{3+} . Also, some fluorescence sensors for Y^{3+} have also been reported, that shown molecular recognition capability for the Y^{3+} metal ions [7,8]. In addition, only a limited number of Y^{3+} samples have thus far been examined [9]. As such, the developments of more effective, rapid, and selective colorimetric or spectrophotometric methods with the capability to detect Y^{3+} ions with nanomolar-level sensitivity are needed. To the best of our knowledge, the present work is the first report on the sensitive colorimetric detection and determination of Y^{3+} using chlortetracycline (CTC)-functionalized silver nanoparticles (AgNPs-CTC) with a dependable and rapid absorbance response.

Organic compounds with electron-donor functionality are important in analytical chemistry, where they participate in environmental, biological, medicinal, and organometallic coordination reactions for binding with metal ions [10]. Members of the tetracycline class of

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Capacitive property studies of inexpensive SILAR synthesized polyaniline thin films for supercapacitor application

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Abstract

The polyaniline (PANI) is an eco-friendly conductive polymer which has been considered for diverse applications. The partially oxidized phase of the PANI is useful for the charge storage application. Here, a unique nanograin/nanofiber structured PANI was grown on inexpensive stainless steel (SS) current collector by the simple oxidative polymerization process and its charge storage properties were systematically investigated. For that, the inexpensive successive ionic layer adsorption reaction method was used to grow a uniform nanostructured PANI on the SS conductor. This evolution of the nanostructure was studied with the Field emission scanning electron microscope. Furthermore, the as-prepared PANI was confirmed by the X-ray diffraction and the Fourier-transform infrared spectroscopy. In the half cell electrochemical testing, the prepared PANI exhibited a maximum specific capacitance of 710 F g^{-1} with a specific discharge capacity of 119 mAh^{-1} at 0.2 mA cm^{-2} in $1 \text{ M H}_2\text{SO}_4$ for the supercapacitor application. Also, by using the power-law relation it was observed that, in a charging and a discharging current, initially a contribution of the diffusive faradaic reactions is more as compared with the surface capacitive non-faradaic reactions.

Keywords Polyaniline (PANI) · Supercapacitor · SILAR · Stainless steel · Power-law · Charge storage

1 Introduction

Evolution in the electrical systems for a wide spectrum of application in recent years have been increased the demand for electrical energy consumption [1, 2]. The sophisticated energy storage units with desired energy-power output for targeted electrical systems has been the main goal in front of the research community. In the global market, batteries, supercapacitors (SCs), hybrid energy storage systems have been providing the desired requirements of electrical systems. Among several energy storage systems, the Li-ion batteries are still dominating in the market for different applications, from the medical devices to the hybrid vehicles as the main central electrical energy storage and supplying system (EES) unit [3–5].

However, SCs with low initial capital costs, low operation-maintenance costs, with easy and efficient operation, high power density have been considered as the best option for main backup EES unit [6–8].

The materials generally used in the SC's stores electrical energy either in the form of columbic (electric double layer) and faradaic (redox reaction) charge transfer process or the combination of both, which influences its power-energy output [9, 10]. The SCs having more electric double layer transitions can deliver more electric power density due to the fast charge transfer rate of adsorbed ions on the electrode surface. Whereas, the SCs having more redox transitions can deliver low power density due to poor charge transfer rate [11, 12]. More surface adsorption reaction in the charge transfer process increases the

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Nanorods to hexagonal nanosheets of CuO-doped manganese oxide nanostructures for higher electrochemical supercapacitor performance

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ABSTRACT

In this work, the extraordinary properties of CuO addition on the morphology and supercapacitive performance of Mn₂O₃ electrodes were demonstrated. Concisely, CuO/Mn₂O₃ thin films were prepared by an easy and inexpensive successive ionic layer adsorption and reaction (SILAR) method. The prepared thin films were characterized by various sophisticated physicochemical systems. The results demonstrated formation of Mn₂O₃ thin films with noteworthy morphological alteration upon introduction of CuO. Furthermore, a significant effect of CuO introduction was observed on the electrocatalytic properties of the nanostructured Mn₂O₃ electrodes. At 3% CuO doping, the Mn₂O₃ electrodes displayed the maximum specific capacitance owing to formation of nano-plate-like structures. The enhanced specific capacitance attained for 3% CuO doping in the Mn₂O₃ electrode was 500 F/g at 5 mV/s in a 3 M KOH electrolyte. All results confirmed the plausible potential of the CuO/Mn₂O₃ electrode for supercapacitor applications.

1. Introduction

In recent years, supercapacitors have emerged as good candidates for different energy storage applications owing their excellent power density, extensive cycle life, high rate capability, high reversibility, and extremely fast charging/discharging [1]. The increasing energy demands and the consequent environmental impact have encouraged a search for alternative clean and sustainable energy storage technologies with high efficiency and excellent performance [2]. Accordingly, considerable attempts have been made to find a suitable electrode materials with decent capacitive features analogous to those of NiO, CoOx, CuO, MnO₂, Fe₃O₄, etc. [3–7]. Among the different transition metal oxides, manganese oxide has attracted attention because of its low cost, environmental friendliness, high energy density, universal abundance, high theoretical capacity (1370 F/g), and excellent electrochemical properties for applications in supercapacitors and use as an electrocatalyst in basic reagents for the oxygen reduction reaction (ORR) [2,8–10].

Different strategies have been proposed to boost the electrochemical properties of manganese oxides. The electrochemical features of a

substance are mainly determined by their electronic structure. Extra energy states can be introduced to metal oxides by doping other materials to alter their electronic characteristics [8]. The most prominent method to enhance the specific capacity of metal oxide is the addition of metal ions to develop desired mixed metal compounds [11]. The doping of heteroatoms can strengthen the pseudocapacitive and electrochemical properties of manganese oxides [8]. Among different metal dopants, the copper cation is considered as a superior dopant because of its electrical conductivity, environmentally benign nature, and low cost [2,12]. P-type materials such as CuO and manganese oxides with a tiny band gap ($E_g = 1.2$ eV) are considered dynamic materials in batteries and supercapacitors [2]. Copper-based manganese oxides material has been used as catalyst for the oxidation of CO [13], hydrogenation reaction [14], oxidative decomposition of ethyl acetate [15], and oxidation of 5-hydroxymethylfurfural [16], Fe, and Mn doped CuSe [17].

Recently, Li et al. prepared various transition metal (Fe, Co, Ni, and V) ion-doped MnO₂ on carbon for the ORR and supercapacitor applications. They prepared manganese oxides nanosheets by a redox reaction between the macroporous carbon and a KMnO₄ solution. They found that the electrochemical performance can be improved by doping

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Facile Synthesis of Triphenylamine Based Hyperbranched Polymer for Organic Field Effect Transistors

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Abstract: In this study, we reported the synthesis and characterization of a novel hyperbranched polymer (HBPs) *tris*[(4-phenyl)amino-*alt*-4,8-bis(5-(2-ethylhexyl)thiophen-2-yl)benzo[1,2-b:4,5-b']dithiophene] (PTPABDT) composed of benzo[1,2-b:4,5-b']dithiophene (BDT) and triphenylamine (TPA) constituent subunits by A₃ + B₂ type Stille's reaction. An estimated optical band gap of 1.69 eV with HOMO and LUMO levels of −5.29 eV and −3.60 eV, respectively, as well as a high thermal stability up to 398 °C were characterized for the synthesized polymer. PTPABDT fabricated as an encapsulated top gate/bottom contact (TGBC), organic field effect transistors (OFET) exhibited a p-type behavior with maximum field-effect mobility (μ_{max}) and an on/off ratio of $1.22 \times 10^{-3} \text{ cm}^2 \text{ V}^{-1} \text{ s}^{-1}$ and 7.47×10^2 , respectively.

Keywords: benzo[1,2-b:4,5-b']dithiophene; triphenylamine; Stille reaction; OFET

1. Introduction

Solution processable π -conjugated semiconductors, a subset of organic materials, has progressively attracted much attention from both academic and industrial applications as the best candidate for lightweight, transparent, flexible electronic devices with less production cost for high throughput processing [1–4]. These materials have been fabricated as active organic layers in organic field-effect transistors (OFETs), organic photovoltaic (OPV) cells, and organic light emitting diodes (OLEDs) [5,6]. OFETs remain as the fundamental building block for flexible electronics [7,8]. Significant progress has enhanced device performance remarkably and currently considered as viable alternative to amorphous silicon-based transistors [9–12]. In spite of that, further fabrication methods and reliable device models are required for expansion of its application in sophisticated electronics [7,13]. This realization

Silver nanoparticle probe for colorimetric detection of aminoglycoside antibiotics: picomolar-level sensitivity toward streptomycin in water, serum, and milk samples

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Abstract

BACKGROUND: The low cost of aminoglycoside (AMG) antibiotics facilitates their excessive use in animal husbandry and the agriculture sector. This scenario has led to the occurrence of residues in the food chain. After several years of AMG use in antibacterial therapy, resistance to streptomycin has begun to appear. Most of the detection methods developed for AMG antibiotics lacks specificity. A broad target specific nanoprobe would be ideal for detecting the entire class of AMGs. A rapid and sensitive method for the detection of AMGs is urgently needed.

RESULTS: Gallic acid-coated silver nanoparticles (AgNPs) were demonstrated as a nanoprobe for the colorimetric detection of AMGs (yellow to orange / red). A linear dynamic range of 50–650 pmol L⁻¹ was achieved readily by ratiometric spectrophotometry (A_{560}/A_{400}) with a limit of detection (LOD) as low as 36 pmol L⁻¹. The amine-groups of the AMGs function as molecular linkers, so that electrostatic coupling interactions between neighboring particles drive the formation of AgNP aggregates. The assay can also be applied for the determination of streptomycin residues in serum and milk samples.

CONCLUSION: This study revealed the potential of an AgNP probe for the rapid and cost-effective detection of low-molecular-weight target analytes, such as the AMGs. A ligand-induced aggregation of AgNPs coated with gallic acid was reported to be a rapid and sensitive assay for AMGs. Analysis of streptomycin was demonstrated with excellent picomolar-level sensitivity. Thus, the validated method can find practical applications in the ultrasensitive detection of AMGs in complex and diagnostic settings.

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Keywords: AgNP probe; ratiometric assay; picomolar sensitivity; antibiotics residues; food safety

INTRODUCTION

Aminoglycoside (AMG) antibiotics are RNA-binding drugs with a common core structure called the streptamine ring. They bind to the ribosomal subunit, thereby hindering mRNA translation and finally leading to nonsense mutation and rapid cell death. Aminoglycoside antibiotics are known for their broad-spectrum antibacterial action against a range of gram-negative aerobic bacteria.¹ However, the substantial variation between the administered AMG antibiotic dose and variations in the resultant levels in the blood is of great concern.² The negative impact of antibiotic residues in food and water has also received worldwide attention due to their abuse in animal husbandry and agricultural practices.^{3,4} This global scenario has emerged as a pressing concern owing to the evolving multi-drug resistance observed for bacteria.⁵ There is thus an urgent need to develop novel assays with high selectivity and sensitivity for the detection of AMG antibiotics in water and food samples.

Streptomycin is a broad-spectrum AMG antibiotic that was discovered in 1943 from a soil actinomycete, *Streptomyces griseus*.⁶

It is effective for gram-negative bacterial treatment and is used not only in controlling human diseases but also in modern agriculture

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High-performance symmetric supercapacitor; nanoflower-like NiCo₂O₄/NiCo₂O₄ thin films synthesized by simple and highly stable chemical method

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Article

Extracellular Synthesis and Characterization of Silver Nanoparticles—Antibacterial Activity against Multidrug-Resistant Bacterial Strains

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Abstract: Herein, we report the use of a cell-free extract for the extracellular synthesis of silver nanoparticles (AgNPs) and their potential to address the growing threat of multidrug-resistant (MDR) pathogenic bacteria. The reproducibility of AgNP synthesis was good and AgNP formation kinetics were monitored as a function of various reaction factors via ultraviolet-visible absorption spectroscopy. This green method was dependent on the alkaline pH of the reaction mixture. With the addition of dilute sodium hydroxide, well-dispersed AgNPs could be produced in large quantities via the classical nucleation and growth route. The new biosynthetic route enabled the production of AgNPs within a narrow size range of 4 to 17 nm. The AgNPs were characterized using various techniques and their antibacterial activity against MDR pathogenic bacteria was evaluated. Field-emission scanning electron microscopic imaging revealed prominent morphological changes in *Staphylococcus aureus* cells due to mechanical damage, which led to cell death. *Escherichia coli* cells showed signs of contraction and intracellular fluid discharge as a consequence of disrupted cell membrane function. This new biologically-assisted extracellular strategy is potentially useful for the decontamination of surfaces and is expected to contribute to the development of new products containing AgNPs.

Keywords: extracellular nanosynthesis; green chemistry; silver nanoparticles; intracellular fluid discharge; pathogenic bacteria

1. Introduction

The frequent and widespread use of antibiotics in the last few decades has led to the development of antibiotic-resistant bacteria. In recent years, *Escherichia coli* (*E. coli*) and *Staphylococcus aureus* (*S. aureus*) have been identified as the sources for most common infections. Multidrug-resistant (MDR) pathogens are known to cause scalded skin syndrome, meningitis, endocarditis, osteomyelitis, food poisoning, urinary tract infections, pneumonia and diarrhea worldwide [1–3]. Resistance in pathogenic microorganisms poses a severe threat to global public health because conventional antibiotics will no longer be effective [4,5]. Thus, there is an urgent need for the development of novel antibiotics, antimicrobial agents and nanomaterials that exhibit strong antimicrobial activity without the induction of resistance in bacterial strains.

Oxide nanomaterials, including copper, zinc, cerium and iron, appear promising as antibacterial agents. However, oxide nanomaterials are limited by their poor dispersibility and

Journal Pre-proof

Gallic acid-functionalized silver nanoparticles as colorimetric and spectrophotometric probe for detection of Al^{3+} in aqueous medium

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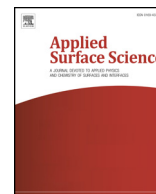
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Full Length Article

Assembling ZnO and Fe₃O₄ nanostructures on halloysite nanotubes for anti-bacterial assessments

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Biofilms

ABSTRACT

This study reports anti-bacterial assessments of 'halloysite nanotubes (HNTs) surface-tuned with Fe₃O₄ and ZnO nanostructures (M-HNTs-ZnO)' against the non-drug resistant pathogenic *E. coli* and *S. aureus*, drug-resistant methicillin-resistant *S. aureus* (MRSA) and their respective biofilms. Naturally occurring clay mineral the halloysite nanotubes (HNTs) are emerging materials in nano-bio-medicines. Fabricating HNTs' tunable surface with anti-bacterial nanomaterials can be a significant application in combating the deadly bacterial infections. SEM, TEM, FT-IR, XPS and VSM analysis corroborated a successful synthesis of M-HNTs-ZnO. The acquired results established the significant anti-bacterial potential of M-HNTs-ZnO against the *E. coli*, *S. aureus* and MRSA, respectively. The stepwise modifications made on HNTs enhanced anti-bacterial performance. Detailed SEM image analysis established possible anti-bacterial mechanisms. M-HNTs-ZnO found effective against the successfully established biofilms of *S. aureus*. The M-HNTs-ZnO applied in repeated anti-bacterial performance against *E. coli*, *S. aureus* and MRSA, marked its importance for water-treatments. In conclusion, M-HNTs-ZnO showed significant anti-bacterial properties that can be used in the treatment of infectious diseases. Also, its repeated anti-bacterial capabilities might be applied in water disinfection protocols.

1. Introduction

The use of antibiotics dominated as a treatment for the pathogenic micro-organisms in the last century [1]. The dramatic increase in antibiotic resistance of pathogenic bacteria constitutes one of the major threats to human health [1,2]. To combat these problems, several antimicrobial nanomaterials have been studied in recent years for the replacement of antibiotics. Despite this, the robust nano-material with natural-availability, higher-efficiency, and multi-functional properties are necessary to be investigated. However, the highly-applicable and multi-dimensional materials which have the anti-bacterial effect to methicillin-resistant *Staphylococcus aureus* (MRSA) and their biofilms can counter the rising drug-resistance in micro-organisms.

Halloysite nanotubes (HNTs) are the biocompatible materials, known for exceptional drug carrier potential [3–6]. HNTs are naturally

occurring clay mineral having a significant potential of the surface modification for diverse applications [3]. Structurally, HNTs [Al₂Si₂O₅(OH)₄·2H₂O] are made up of aluminosilicate layers with the composition of aluminum, silicon, hydrogen, and oxygen [7]. HNTs structure shows hollow-tubular nature with an inner-lumen diameter of 5–20 nm and the length of the tube is in the range of 0.5–10 μm [8]. Chemistry of HNTs includes a tubular morphology with the Al–OH sheet forming the inside and the Si–O sheet the outside [9,10]. The HNTs' outer surface mainly covered by Si–O–Si groups and have some Si–OH groups present on the edges [11]. HNTs nano-tubular framework provides there utilization in diverse applications including; environmental, catalytic, and nano-medicinal [12]. Due to their outstanding properties, HNTs are widely used in many emerging applications. So, the impact of the HNTs on human health and the environment needs to test. The biocompatibility of HNT is one of the

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Short Communication

Microwave assisted synthesis of imidazolyl fluorescent dyes as antimicrobial agents



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ABSTRACT

In this article, we report, the synthesis and characterization of series of novel fluorescent imidazolyl dyes (5a-d) via highly efficient and cost-effective microwave assisted protocol as a potential candidate to overcome the problem of microbial resistance. By utilizing the green microwave protocol the reactions are completed in a short span of time without using the harsh conditions. The incorporation of imidazole nucleus is an important strategy in drug discovery. While designing desired fluorescent imidazole dyes 5a-d, with a suitable auxiliary donor such as aromatic rings and $-OCH_3$ group on one end of the imidazolyl moiety and electron acceptors such as $-NO_2$ and $-COOH$ on other end of the compounds was achieved to get a promising fluorescent dyes for antimicrobial. The optoelectronic properties and antimicrobial studies of the synthesized materials indicated their exploration as a promising candidate as antimicrobial agents.

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Original Article

Fabrication of nanostructured $\text{SnO}_2@\text{Co}_3\text{O}_4$ /nitrogen doped graphene oxide composite for symmetric and asymmetric storage devices



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ABSTRACT

The fabrication, and characterization of $\text{SnO}_2@\text{Co}_3\text{O}_4$ /NGO composite with a nanogranular-like morphology was synthesized by a thermal reduction process in presence of ammonia and urea as catalyst. The structure and morphology of the composite were investigated by sophisticated techniques. Cyclic voltammetry was performed to determine the electrochemical performance of the composite electrode for supercapacitor applications. The composite symmetrical electrode was displayed a specific capacitance of $\sim 375 \text{ F g}^{-1}$ at 0.5 A/g in a 2 M KOH aqueous electrolyte with a capacity retention of $\sim 93\%$ after 10,000 cycles. The $\text{SnO}_2@\text{Co}_3\text{O}_4$ /NGO composite asymmetric electrode exhibited a specific capacitance of $\sim 256 \text{ F/g}$ at 1 A/g and excellent cyclic retention. The improved electrochemical properties of the composite depends on the nanogranular-like morphology, large surface properties, and excellent conductive networks. Therefore, the ternary oxide@NGO composite electrode is promising architecture for energy storage applications.

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Designing of nanoflakes anchored nanotubes-like MnCo_2S_4 /halloysite composites for advanced battery like supercapacitor application

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ABSTRACT

In this study, we report a facile chemical synthesis of a novel MnCo_2S_4 /halloysite (HNTs) nanoflakes decorated on nanotubes which coated on Ni foam via a screen-printing technique. The MnCo_2S_4 thin films were prepared using a coprecipitation method which demonstrate battery kind of behavior. The MnCo_2S_4 /HNTs-based electrode shows a specific capacity of 359 mAh g^{-1} at 5 mV s^{-1} with excellent cycling stability. Furthermore, the symmetric system exhibits an outstanding energy density and power density of 6.98 Wh kg^{-1} and 1976.0 W kg^{-1} , respectively. The results obtained with the MnCo_2S_4 /HNTs composite in a symmetric system indicate that this composite material can potentially be used as an alternative electrode material for electrochemical energy storage.

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1. Introduction

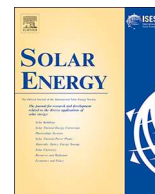
In recent years, world pollution has rapidly increased, necessitating the development of alternative energy sources and storage schemes. Although the existing energy sources and storage techniques are convenient, they face various limitations such as low abundance and poor renewability [1–5]. Examples of non-renewable energy sources include fuels such as oil, coal, natural gas, and wood [5–7]. Overcoming such problems involves the progress of novel energy storage systems that alleviate

environmental pollution, are based on a renewable energy source, and are green and cost effective. To this end, solar cells, supercapacitors, batteries, and capacitors are now commercially available [8–10]. Solar cells, batteries and supercapacitors are the most capable electrical energy storage systems. In supercapacitors, battery type materials are particularly promising because they show outstanding characteristics such as high energy and power densities and good long-term cycling stability; they also do not generate environmental pollution and are inexpensive to fabricate [11–15].

Currently, many researchers are developing various binary and ternary metal oxide/hydroxide/chalcogenide nanostructures [16–20] for use in supercapacitors [21], batteries [22], dye-sensitized solar cells [23], sensors [24], water-splitting [25], hydrogen/oxygen evolution [26,27], and various electronic devices. Among these transition-metal chalcogenides, we have chosen

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Synergistics of Cr(III) doping in TiO₂/MWCNTs nanocomposites: Their enhanced physicochemical properties in relation to photovoltaic studies

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ABSTRACT

In the present investigation, optoelectronic modifications of the TiO₂ host lattice through insertion of Cr(III) (0.5–3.0 mol.%) as a dopant and thereafter its composites with MWCNTs prepared using single step *in-situ sol-gel* route and its photovoltaic performance of the hybrids was investigated using Ru(II) based sensitizer. The physicochemical properties (viz. structural, opto-electrical, morphological and charge transfer behavior) of the ternary Cr@TiO₂/MWCNTs NCs are compared with the TiO₂/MWCNTs NC through various spectroscopic (XRD, Raman, UV–Visible DRS, XPS, FT-IR, PL, TRPL and EIS measurements) and microscopic (HR-TEM with SAED) analysis. TRPL and EIS studies reveals that, average life time of the electrons in the excited state increases and interfacial charge transfer resistance decreases after the insertion of Cr(III) ion into the TiO₂ host lattice. After the detailed physicochemical investigations, binder free NCs were deposited on the F:SnO₂ (FTO) by doctor-blade technique using DMF and CH₃CN solvents and then anchored with N719 dye. Finally, sensitized photo-electrode sandwiched with Pt-counter electrode for making the sandwich dye sensitized solar cells (DSSCs) and photovoltaic performance of the assembled devices was measured under AM 1.5 solar simulator for *I-V* and *IPCE* measurements. The Cr_{0.010}@Ti_{0.990}C NCs based DSSCs shows highest photovoltaic conversion efficiency up to $\eta = 7.69\%$ which is 20% ($\eta = 6.18\%$) higher to that of undoped TiO₂/MWCNTs based DSSCs.

1. Introduction

Recently, semiconducting ternary nanocomposites (NCs) have pivotal role in the leading potential fields of the sustainable survive viz. energy conversion and storage (Chen et al., 2015; Rakhi et al., 2012; Santra and Kamat, 2013), environmental remediation (Deng et al., 2017), catalysis (Miao et al., 2017), sensing (Malik et al., 2018), biomedical (Regulacio et al., 2018), and electronics (Hu et al., 2018) due to their well coverage of the optical region of electromagnetic spectrum (Liu et al., 2013), tuning electronic properties (Mao et al., 2011), and separation of charge carriers (Mondal et al., 2018) etc. Among these potential applications, energy harvesting has a priority choice due the present need of the sustainable energy and available conventional energy sources are insufficient to consume the modern society and also injurious to environment (Yun et al., 2018). Hence, from last two decades investigators intent on the efficient conversion of highly

abounded sunlight into electrical energy through low cost, stable dye sensitized solar cells (DSSCs) compared to conventional Si-based solar cells and recently used perovskite based solar cell devices (Mathew et al., 2014). From the discovery of DSSCs (O'regan and Grätzel, 1991), investigators demonstrated, the semiconducting TiO₂ acts as an efficient photocatalyst compared to others such as SnO₂ (Snaith and Ducati, 2010), ZnO (Sakai et al., 2013), Nb₂O₅ (Ou et al., 2012), and SrTiO₃ (Tang and Yin, 2015) etc. utilized for the DSSCs. Because of its tunable morphology (Bai et al., 2014), opto-electronic properties (Lee et al., 2012) higher chemical stability (Lee et al., 2012) and higher dye loading capability compared to others (Bai et al., 2014). Also its HOMO-LUMO levels are well matchable to the excited dye (De Angelis et al., 2011), and hence recently reported the highest photovoltaic conversion efficiency up to 14.5% for TiO₂ based DSSCs (Kakiage et al., 2015). With these advantages, it has some constrains viz., it active only in the UV region due to its wider energy band gap (Dette et al., 2014), and

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Article

Chlortetracycline-Functionalized Silver Nanoparticles as a Colorimetric Probe for Aminoglycosides: Ultrasensitive Determination of Kanamycin and Streptomycin

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Abstract: Aminoglycosides (AMGs) have been extensively used to treat infectious diseases caused by Gram-negative bacteria in livestock and humans. A selective and sensitive colorimetric probe for the determination of streptomycin and kanamycin was proposed based on chlortetracycline-coated silver nanoparticles (AgNPs-CTC) as the sensing element. Almost all of the tested aminoglycoside antibiotics can rapidly induce the aggregation of AgNPs, along with a color change from yellow to orange/red. The selective detection of aminoglycoside antibiotics, including tobramycin, streptomycin, amikacin, gentamicin, neomycin, and kanamycin, with other types of antibiotics, can be achieved by ultraviolet (UV) spectroscopy. This developed colorimetric assay has ability to detect various AMGs using in-depth surface plasmon resonance (SPR) studies. With this determination of streptomycin and kanamycin was achieved at the picomolar level (pM) by using a UV–visible spectrophotometer. Under aqueous conditions, the linear range of the colorimetric sensor for streptomycin and kanamycin was 1000–1,1000 and 120–480 pM, respectively. The corresponding limit of detection was 2000 pM and 120 pM, respectively. Thus, the validated dual colorimetric and ratiometric method can find various analytical applications for the ultrasensitive and rapid detection of AMG antibiotics in water samples.

Keywords: chlorotetracycline antibiotics; silver nanoparticles; ultrasensitive detection; aminoglycoside antibiotics; water samples; picomolar level sensitivity

To Compare the Effect of Improvement the Maximal Oxygen Uptake (VO₂ Max) Capacity through Training Programs

Bharat Bhujbal*

ABSTRACT

This study presents hypothetical study comparing the improvement of the whole body maximal oxygen uptake (VO₂max) when training with different methods at different intensities matched for total work performance and frequency of training. We compare VO₂max improvement in two training methods. The methods are group of functional exercises and other is suryanamaskar and pranayama method. The study was conducted on 75 female students of 18 to 20 age having almost everyone has same physical ability. The selected subjects were measured of their physical fitness component maximum oxygen uptake capacity with Queens College 3 Minutes Step Test. The total fitness standard of sample was calculated by converting the raw scores into standard scores. The data was analysed by applying repeated measure ANOVA test and Post Hoc test for multiple comparisons.

Keywords: Cardiorespiratory fitness, VO₂max, maximal oxygen uptake training methods, Queen's College Step Test, physical fitness.

INTRODUCTION

VO₂ max is generally considered as the best indicator of cardiorespiratory fitness. Cardiorespiratory fitness is an important health variable, which is associated with several risk factors for cardiovascular diseases. VO₂ max is a physiological parameter by which we are able to estimate body consumes how much oxygen when working at a very high level of exercise. Cardiorespiratory fitness is measured by VO₂max which is one of the most often used tests to evaluate endurance capacity. It is a best way to evaluate overall body function and health. It measures an aerobic fitness. Training programs are help to increase the VO₂ max and improve overall fitness. Cardiorespiratory and aerobic fitness level are depends on lung capacity and heart volume, capillary delivery and muscle efficiency. When lung capacity is more the heart can pump more oxygenated blood that's why more oxygenated blood reach to the muscles through capillaries. Oxygenated blood supply to the muscles through the capillaries increases the efficiency of the muscles. Increasing muscle function increases the body's ability to function as a whole. Cardiorespiratory fitness is mainly increased through aerobic endurance exercises but in some not fit or diseased populations a small benefit can be achieved by muscular strength exercise (ACSM 2006b, Pollock M., et al 2000).

It is my intension to do this study to develop more oxygen capacity using the proper training methods. There is a great lack of exercise in college girls. There are many reasons for this, indifference

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