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AN EXPERIMENTAL STUDY ON EFFECT OF METAKAOLIN AND IRON ORE TAILINGS ON THE PROPERTIES OF HIGH STRENGTH CONCRETE

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ABSTRACT

Concrete is basic common important material used in the construction industry in the past few decades, many research and modifications has been carried out to produce concrete with desired characteristics. There is always a research for concrete with higher strength and durability. The use of supplementary materials in cement is fundamental in developing low cost construction materials for use in developing countries. Concrete is the most widely used material having high compressive strength, by adding some of the pozzolanic materials, the various properties of concrete such as workability, durability, strength resistance to cracks and permeability can be improved with materials. To determine the physical properties of the river sand, crushed stone, metakaolin, iron ore tailings (IOT) such as specific gravity and grain size distribution and the mechanical properties of the control mix for M50 grade of concrete mix by considering optimum percentage of IOT as 30% constant and varying the metakaolin percentage i.e. 0,5,10,15 and comparing the results with the control mix at 7,14, 28 and 56 days. Tests were conducted to assess the physical properties of cement, metakaolin, fine aggregates, coarse aggregates and IOT. Mix design of M50 grade concrete is done by selecting suitable ingredient of concrete and determine their proportion. The samples were casted for 5 different mix proportions for metakaolin replaced with cement and iron ore tailing replaced with sand. Cube size of 150mm*150mm*150mm, cylinder of diameter 150mm and length 300mm and beams of dimensions 500mm*100mm*100mm were casted for M50 grade concrete mix and curing was done for 7,14, 28 and 56 days.

I. INTRODUCTION

In recent times the development of high strength and high-performance concretes has increased considerably because of the demands from the construction industry. In the last three decades, fly ash, silica fume and ground granulated blast furnace slag which has cementitious materials have been utilized as cement replacement materials as these can significantly increase the strength and durability characteristics of concrete with comparison of ordinary Portland cement (OPC) (Neville 1997). Hence, high-performance and high strength concretes can be produced at lower w/b ratios by mixing these supplementary materials.

Concrete is basic common important material used in the construction industry in the past few decades, many research and modifications has been carried out to produce concrete with desired characteristics. There is always a research for concrete with higher strength and durability. The use of supplementary materials in cement is fundamental in developing low cost construction materials for use in developing countries. Concrete is the most widely used material having high compressive strength, by adding some of the pozzolanic materials, the various properties of concrete are workability, durability, strength resistance to cracks and permeability can be improved with materials. Addition of many admixtures in cement concrete which can improve the microstructures of the concrete as well as decrease the concentrations of calcium hydroxide through pozzolanic reaction.

The materials which are used for the construction of roads plays an important role including with its design. Due to the depleting natural resources and ban in sand mining in different parts of our country, replacement of these natural resources with industrial waste is being experimented in laboratory scale by various researchers. The different industrial waste reported by previous researchers are fly ash, Ground Granulated Blast Furnace Slag (GGBS), marble waste, quarry dust, glass powder, metakaolin, alccofine, etc. Similarly, various mine waste such as sandstone, limestone, coal, etc. are being replaced as fine aggregates to determine its strength properties.

OBJECTIVES

- To determine the physical properties of the river sand, crushed stone, metakaolin, iron ore tailings necessary experiments were carried out such as specific gravity and grain size distribution.
- To determine the mechanical properties of the control mix for M50 grade of concrete.
- To determine the mechanical properties of the concrete mix by considering optimum percentage of IOT as 30% constant and

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Bioethanol Production from Green Alga *Chlorococcum minutum* through Reduced Graphene Oxide-Supported Platinum-Ruthenium (Pt-Ru/RGO) Nanoparticles

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Abstract
Due to the continuous depletion of non-renewable fossil fuels, there is a focus on renewable energy sources such as bioethanol, biobutanol, biohydrogen and biodiesel. Microalgae have been used to yield high sugar content via alteration of the photosynthetic pathway, thereby enhancing ethanol production. Moreover, certain nanostructured composites in the medium supports biomass enhancement through modification of the photosynthetic pathway. In the present study, reduced graphene oxide-supported platinum-ruthenium (Pt-Ru/RGO) nanoparticles were synthesised, characterised and assessed the role in tris–acetate phosphate (TAP) medium for the improvement of green alga *Chlorococcum minutum* (*C. minutum*) biomass under *in vitro* conditions. Chemically, Pt-Ru/RGO nanoparticles play a useful role as a catalyst in the improvement of chemical reactions and influence the electron supply/transport system. Total chlorophyll and wet biomass contents were 8.26 mg/L and 14.0 g/L in TAP with 1.0 mg/L of nano-Pt-Ru/RGO (CM2) medium when compared with untreated cultures, but total lipid content was more (24.5 g/100 g) in TAP with 0.5 mg/L of nano-Pt-Ru/RGO (CM1) medium. Later, these nano Pt-Ru/RGO-assisted algal feedstocks were used to convert sugars into ethanol by *Saccharomyces cerevisiae* (yeast) dark fermentation. The current standardised TAP media in the presence of 0.5 or 1.0 mg/L of Pt-Ru/RGO nanoparticles (CM1 or CM2 medium) improved the ethanol production (32.6 and 31.2 g/L at 72 h respectively) from feedstocks of *C. minutum*. In conclusion, Pt-Ru/RGO nanoparticles can enhance the chemical reactions in photosynthesis likely at the electron transport system and increased the biomass in turn ethanol production.

Keywords Nano Pt-Ru/RGO · Microalgae · *C. minutum* · Biomass · Bioethanol

Introduction

The heavy use of fossil fuels for automobiles and industries is contributing to a non-renewable energy crisis. Electric vehicles on the other hand are expensive and support only short-distance travel [1]. To reduce the fuel crisis, it is important to use renewable fuels such as solar energy, wind energy and biofuels [2]. Also, the burning of fossil fuels causes greenhouse gas (GHG) emissions contributing to global warming. Biomass-based fuels are safe and reduce greenhouse gas emissions and their associated pollution [3, 4]. Most biomass-based biofuels such as bioethanol, biobutanol and biodiesel have been generated from food and oil crops, which is a threat to food security [5]. Algae are an excellent biofuel resource which might fulfill the increasing demand for energy to some extent due to their potential yield [6, 7]. Algae are primitive plants and possess a high content

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ORIGINAL RESEARCH

Heuristic ant colony and reliable fuzzy QoS routing for mobile ad hoc network

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Abstract
The furthermost important issues in mobile ad hoc network (MANET) are to provide a multi-path and multi-constraint qualify of service (QoS) routing for uninterrupted communication between the nodes. On one hand multi-constrained QoS routing deal with identifying paths that assure numerous autonomous QoS limitations and on the other hand, multi-path refers to the identification of multiple paths. Besides due to higher rate of topological changes and the energy constrained nodes in the network, literature survey provides us ant colony optimization (ACO), a unique variety of optimization procedure which was found to be extremely convenient for identifying reliable routing. To deal with following concerns, we suggest a multi-path multi-constraint energy-efficient routing method. In the projected method, calculate the metrics such as end to end delay and QoS monitoring agents collect, link stability, energy consumption, available bandwidth, and packet loss rate. The proposed method is called as the heuristic concurrent ACO and reliable fuzzy (HEACO–RF) QoS routing protocol for MANET. The HEACO–RF QoS routing protocol for MANET includes two phases. In the first phase, the ant colony optimization algorithm is modified to identify a deposit of candidate routes among a pair of source and destination. While identifying the candidate routes along with the QoS metrics, heuristic factors and reliable fitness functions are also considered. In the second phase, the reliability technique is used to measure each path and the paths with high reliability is selected by the ant agents using fuzzy logic based on the metrics link stability, residual energy, and packet loss rate. Simulation outcomes prove that HEACO–RF QoS routing protocol decreases the energy consumption and improves the packet delivery ratio, packet loss rate with minimum delay.

Keywords Ant colony optimization · MANET · Qualify of service (QoS) · Heuristic concurrent ACO and reliable fuzzy

1 Introduction

Mobile ad-hoc networks (MANETs) is the network with self arrangement, dynamic network nature without possessing any pre-structured infrastructure (Preeth et al. 2018). With the existence of dynamic geography and appropriated nature, multipath steering is an extraordinary worry in MANETs. Multipath directing techniques are reliable on adjoining hubs for distinguishing the briefest way that distinctive information packets are exceptionally helpless to arrange traffic (Malar et al. 2020). Mindfulness on the adjoining nodes brings about start to finish delay while broadcasting information parcels to other contiguous nodes resulting in congestion (Ullah et al. 2019).

A novel link disjoint multipath (LDM) transmitting was investigated in Lakas et al. (2019) with the objective of solving the issues related to the optimization issue in real-time system ecosystem. The LDM method selected the shortest path from the available multiple paths in MANETs. In LDM, every intermediate node was utilized for providing a lively switch system and hence identified the best probable path. With this type of dynamic system bounds, efficient path was said to be identified within the purview of the dynamic network challenges.

With this the method was proven to be efficient by means of dependability, energy efficiency, traffic load and so on. Despite efficiency achieved in terms of energy being consumed in a reliable manner with balanced traffic load, packet loss rate and delay incurred while identifying the best probable path was not concentrated. To address this issue, in this

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High efficiency dense light field and all-in-focus compression for lossless satellite image by using CCSDS

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Abstract
Light-field enables us to observe scenes from free view-points. However, it generally consists of 4-D enormous data, which are not suitable for storing or transmitting without effective compression. Image acquisition, transmission, interpretation and visualization have witnessed a lot of research interest and have manifold applications in real life. Light field Images popularly known as Plenoptic Images are light rays travelling in every direction. The data sets generated using plenoptic images are large in size and consume a lot of storage space. This paper studies the general process of image acquisition, light field images and various datasets. Image compression will help the users or professionals to not only achieve storage efficiency but also aid in transmission of Images. In this paper, we study efficient compression of multi-focus images synthesized from dense light-field by using DWT instead of DCT-based compression in order to suppress degradation such as block noise. Quality of reconstructed light-field is evaluated by PSNR for analyzing characteristics of residuals. This paper presents the modeling, design and implementation of two IP cores that are compliant with the CCSDS 121.0-B-2 and CCSDS 123.0-B-1 lossless satellite image compression standards. This paper provides a comparative study of various image compression techniques/algorithms and evaluates them on parameters like peak signal to noise ratio (PSNR), mean square error (MSE), Structural Similarity Index (SSI) and compression ratio (CR).

Keywords Plenoptic images · Image compression · Peak signal to noise ratio · Mean square error · Similarity Index · Multi-view · Multi-focus · Compression ratio-CR

1 Introduction

Digital Technology has transformed our lives for the better. Digital Image recognition devices with an increased capacity and lower cost has revolutionized Image processing. Static Cameras are being replaced by mobiles and high resolution image acquisition devices. Smaller devices with higher picture quality is the need of the hour. Plenoptic images are captured by Lytro plenoptic cameras of high resolution and better image quality. However this may result in increase in size of image as the image focusses on many components. Light-field rendering is a promising technique generating 3-D picture from multi-view picture captured by dense camera arrays or lens arrays (Montilla et al. 2015; Ng et al. 2005). However, Light-field generally consists of 4-D enormous data that are not suitable for storing or transmitting without effective compression. The conversion enables novel light-field compression via synthesized multi-focus images as effective representation of 3-D scenes like Fig. 1 (Li et al. 2014). Multi-focus images are easily compressed because they contain mostly low frequency components. In this paper, especially, we study effective compression of multi-focus images by using DWT instead of DCT-based compression (Li et al. 2014) in order to suppress degradation such as block noise on reconstructed light-field.

New digital imaging emerges with a lot of opportunities that enhances viewing, sharing, editing, managing, and preserving images. Light field cameras have microscopic lenses. The data sets acquired by light field imaging are very huge and occupies huge space and consumes high band width. So, good compression algorithms are essential. An uncompressed light field imaging system many times occupy stored space easily exceeds Gigabytes. For storage and transmission

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Thermal radiation and viscous dissipation effects on steady MHD heat and mass transfer flow of a micropolar fluid over an inclined isothermal permeable surface in the presence of thermophoresis

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Abstract: In this paper, The combined effects of thermal radiation and viscous dissipation on steady free convection Magnetohydrodynamic flow of a micropolar fluid over an inclined isothermal plate in the presence of thermophoresis is considered. The governing non linear partial differential equations of the problem are transformed into a system of nonlinear ordinary differential equations through appropriate similarity transformation and shooting technique method with Runge–Kutta Fourth order integration scheme. The effects of various physical parameters on the dimensionless velocity, microrotation, temperature, and concentration profiles are discussed and presented graphically. Finally, numerical values of the physical quantities, such as the local skin friction coefficient, the local Nusselt number and the local Sherwood number are tabulated with the variation of thermal Grashof number, modified Grashof number, magnetic parameter and coupling constant, Radiation parameter, Eckert number, thermophoretic parameter and Schmidt number parameters.

Keywords: *Thermal Radiation; Viscous Dissipation; MHD; Heat and Mass Transfer; Micropolar fluid; Thermophoresis.*

1. Introduction:

The theory of micropolar fluids has received enormous attentions during the recent years since the traditional Newtonian fluids cannot specifically depict the feature of fluid with suspended particles, polar fluids, suspension solutions, liquid crystals, colloidal solutions and fluid containing small additives. Physically, micropolar fluids may present the non-Newtonian fluids consisting of short rigid cylindrical elements or dumb-bell molecules, polymer fluids, fluids suspensions and animal blood. The existence of dust or smoke particular in a gas may also be modeled using micropolar fluid dynamics. Eringen [1] first derived the theory of micropolar fluids, which illustrates the microrotation effects to the microstructures. Eringen [2] extended his idea to the theory of thermomicropolar fluids, which interest to the special effects of microstructures on the fluid flow. The mathematical theory of equations of micropolar fluids and applications of these fluids in the theory of lubrication and in the theory of porous media are given in recent books by Eringen [3] and Lukaszewicz [4]. Free convection in the boundary layer flow of a micropolar fluid along a vertical wavy surface was investigated by Chiu and Chou [5]. Hassanien and Gorla [6] studied the heat transfer to a micropolar fluid from a non-isothermal stretching sheet with suction and blowing. Mixed convection boundary layer flow of a micropolar fluid on a horizontal plate was derived by Gorla [7]. Furthermore, The flow characteristics of the boundary layer of micropolar fluid over a semi-infinite plate in different situations have been studied by many authors in Refs. [8–15]. In the above mentioned works the effect of the induced magnetic field was neglected.

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Convolutional recurrent neural network with template based representation for complex question answering

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ABSTRACT

Complex Question answering system is developed to answer different types of questions accurately. Initially the question from the natural language is transformed to an internal representation which captures the semantics and intent of the question. In the proposed work, internal representation is provided with templates instead of using synonyms or keywords. Then for each internal representation, it is mapped to relevant query against the knowledge base. In present work, the Template representation based Convolutional Recurrent Neural Network (T-CRNN) is proposed for selecting answer in Complex Question Answering (CQA) framework. Recurrent neural network is used to obtain the exact correlation between answers and questions and the semantic matching among the collection of answers. Initially, the process of learning is accomplished through Convolutional Neural Network (CNN) which represents the questions and answers separately. Then the representation with fixed length is produced for each question with the help of fully connected neural network. In order to design the semantic matching between the answers, the representation of Question Answer (QA) pair is given into the Recurrent Neural Network (RNN). Finally, for the given question, the correctly correlated answers are identified with the softmax classifier.

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1. INTRODUCTION

In recent years, the task of question answering plays a major role of information retrieval in human computer interaction. The required information is described in the form of questions or statements [1]. Question Answering systems presenting an interface, where users could state their demand for information in the Natural Language format and the search engine will produce suitable answers to these questions. When compared with the traditional information retrieval system, the relevant amount of information is considered as an answer instead of retrieving the entire document [2]. Data mining is a subfield of computer science that enables intelligent extraction of useful information [3]. The user is expecting correct, comprehensible and concise answer which may indicates the sentence, image, word, paragraph, audio fragment or the whole document [4]. The problem behind this approach is converting the user information in the form of evaluation. It can be accomplished by inferencing and Semantic Web query processing approaches. The application will take advantage of this class structure to determine the semantic similarity. Street and city semantically are closer than street and time [5].

The combination of question focus and question topic is considered as a question. The topics of the question commonly have the conditions or context based on the user characteristics of interest [6]. The interest of the answer is identified by the searching topics which are entered. Several factors of question

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Hierarchy based firefly optimized k-means clustering for complex question answering

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ABSTRACT

Complex Question Answering (CQA) is commonly used for answering community questions which requires human knowledge for answering them. It is essential to find complex question answering system for avoiding the complexities behind the question answering system. In the present work, we proposed Hierarchy based Firefly Optimized k-means Clustering (HFO-KC) method for complex question answering. Initially, the given input query is preprocessed. It eliminates the way of misclassification when comparing the strings. In order to enhance the answer selection process, the obtained keywords are mapped into the candidate solutions. After mapping, the obtained keywords are segmented. Each segmentation forms a new query for answer selection and various number of answers selected for each query. Okapi-25 similarity computation is utilized for the process of document retrieval. Then the answers selected are classified with K means clustering which forms the hierarchy for each answer. Finally the firefly optimization algorithm is used for selecting the best quality of answer from the hierarchy.

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1. INTRODUCTION

Semantic information published on the web is increased rapidly with linked data initiative. However it is typically complex for the user to search and query the vast amount of structured and heterogeneous semantic data [1]. It is essential to build a system which can able to answer from different domain. It is termed as open domain question answering system which should be access the knowledge in novel way [2]. When concern about the stored data, the volume is high and it increases the burden of filtering and browsing the result for retrieving precise information. Question answering system is a technology used to find, extract, and provide a proper answer to the user's query in the natural language format [3]. The repositories are specially made for accomplishing several tasks like question answering, knowledge mining and searching [4]. Data mining is a subfield of computer science that enables intelligent extraction of useful information [5].

Due to its large and growing structure of data, efficient and intuitive techniques are essential to deal with them. The complexity and ease of interference is taken into account while processing the data [6]. Instead of knowing the query language, the knowledge graph extracts the structure and relation between the question and answer [7]. In addition with collaborative information seeking and sharing, collaborative answers are also included. The community agreements among Question Answering (QA) pairs are obtained with micro collaboration and the enhancement of collective intelligence [8]. The keywords from the query are matched with the metadata in which sequence of answers are retrieved for the given query.

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Improving QOS in mobile adhoc networks routing using fuzzy inference algorithm

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ABSTRACT

Mobile Ad hoc Networks (MANET) contains an enormous and moderately thick populace of versatile units that move in any region, and its solitary methods for correspondence is the utilization of remote interfaces without utilizing previous framework or brought together organization. Also, steering ought to give a methodology to sending information whenever between a couple of hubs (i.e., source and objective) over an organization. In any case, the fundamental issue is to decide an ideal steering of parcels over the organization. The fundamental goal of the proposed convention is to locate the minimum cost interest in ostensible limits that guarantees the directing of perceived amount of data packets and ensures its existence in the event of circular segment or hub disappointment. In this unique circumstance, the fuzzy coordinated Petri net is considerably embraced in the displaying of the directing and discovery/choice capacities that utilization a corresponding fuzzy change approach, wherever the proposed framework is utilized to discover an answer for the issue of vulnerability functions in specially appointed organizations. The acquired outcomes illustrate the adequacy of the proposed fuzzy inference algorithm performs well when compared to Route selection algorithm and Ant colony based Routing Algorithm. This proposed fuzzy inference algorithm is evaluated under energy consumption and sensing delay parameters. Our algorithm performs well in both the parameters and ultimately improves quality of service in mobile ad hoc networks.

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1. Introduction

In the ongoing years, the development of remote correspondence advancements and the rise of cell phones (PCs, cell phones, and so on), made the entrance of these gadgets to the organization conceivable anyplace and whenever without interfacing the conveying gadgets to a framework as appeared in Fig. 1. A certain preferred position of these remote technologies is the capacity to be portable while remaining associated. Remote correspondence is less dependable than communication in wired organizations. The proliferation of the sign goes through bothers (e.g., move blunders, miniature break, break, and so on) because of the climate, along these lines changing the moved data. This cycle brings about an expansion in message travel time because of the increment in the number of re sending's of packets. The association can be reduced or adjusted by the versatility of locales when the client moves out of the accepting zone or moves to a elevated impedance area. In the Mobile Ad Hoc NETwork (MANET), portable clients are appreciative to execute the steering of the genuine information because of the absence of framework in this kind of organization. At the point when the objective is exterior to radio scope of the resource, every versatile of the organization fills in as a transfer by re sending the information to another portable unit in anticipation of the required objective is reached. The continuous insecurity is the way because of portability and radio asset imperatives (e.g., variable throughput, restricted data transfer capacity, and so on) presents significant difficulties for this sort of steering.(See Fig. 2)

MANET is an extraordinary instance of portable organizations, and novel ideas has developed to improve the directing dependability to guarantee the nature of data in an organization consists of flexible hubs. Be that as it may, gain versatility is blemished in different viewpoints, for example, speed of correspondence and nature of administration. Contrasted with wired interfaces, a couple of remote interfaces offer quick throughput. Subsequently, steering consists of finding a way between the various components of the organization to communicate something specific between

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ENHANCED POWER CONTROL METHOD IN DC MICROGRID WITH MULTI LEVEL CONVERTERS

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***Abstract*—** Multilevel converters are promising solutions in Small-Scale DC Power Network since they allow the combination of excellent harmonic performance and low switching frequencies. A high reliability can also be achieved by including redundant submodules in the chain of cascaded converters. DC microgrids have been emerging as next generation small-scale electric power networks, where the line impedance is very low. This phenomenon causes large currents in the microgrids, even for a slight change in voltage; therefore, it is critical for a power flow controller to have faster transient response and precise power flow control. In this study, multi-level converters are applied as the power flow controllers to realize high speed and high-precision power flow control in a dc microgrid. The output filter can be small, as a multi-level converter is used. This project also presents the design of the output LC filter of a multi-level converter to satisfy a requirement of current ripple. Here it is verified that a multi-level converter with a smaller filter can realize high-speed and high-precision power flow control for low line impedance conditions compared with the conventional two-level converters. The control performance of each output current is evaluated in the step response, considering the transient changes in the power flow by using MATLAB/Simulink Simulation results.

I. INTRODUCTION

Inverters are very useful for various industrial applications. In the last few years, the voltage-driving method has been adopted. To reduce the semiconductor transient voltage and current rating, a series and parallel connection method is needed. Moreover, the limited standard three-phase converter is also adopted up to the maximum allowable voltage of the load. Also, both the primary and the Pulse width modulation (PWM) switching frequency can be useful. The reduced switching frequency shows the low disappearance and the higher efficiency. In order to synthesize the spectrum signals of the harmonics caused by the capacity, the multi-level inverter has received more attention in recent times. Moreover, a multilevel inverter has a key role in providing improved operating voltage beyond the voltage limits of conventional semiconductors. For low power photovoltaic systems, the classical two-level inverter is typically employed as the interface between dc-link and grid. However, modern wind turbines, which range from hundreds of kilowatts up to a few megawatts, demand special converter structures. One alternative is to connect switching devices in series to cope with the high voltage stress. However, this technique requires a precise method to ensure the voltage share between the devices in dynamic and static situations. Another method that has been well accepted by the industry, and is emerging as the standard solution for high power medium voltage applications, is the Multilevel Converter. These structures have the ability to synthesize the output waveform from several levels of voltages, improving the spectrum quality when compared with the classical two-level topology.

A dc microgrid helps achieve efficient power transfer by reducing the number of power conversion stages between the ac and dc sides, because most grid-tied renewable energy systems deal with dc power on both input and output sides. Line impedances are usually very low in a dc microgrid owing to the shorter distances between the nodes such as the generators, batteries, and loads compared with a large scale ac grid; thus, a large current flows through the lines even for a slight change in voltage. To suppress the excess current, a two-level converter needs a bulky output filter. A part of a grid configuration connecting only two converters and a passive resistive load has been investigated. It proposes an efficient power flow sharing and voltage regulation control method based on a hierarchical control to minimize the transmission loss of the dc micro-grids. The circuit topology used for the above studies in has been mainly the two-level converter. Moreover, an improvement of the dynamic performance has not become their main objectives. Meanwhile, there are studies aiming the realization of the high-speed response of the individual converter. In a control method to realize the fast current response in a dc–dc converter was reported. This method assumes a low voltage power supply with conversion from 5.5 V to 3.3 V and a switching frequency in MHz range to be integrated on a chip or in a package. It proposed a predictive current control for a bidirectional two-level dc–dc converter to enhance the steady-state and dynamic performances of the dc microgrid. In addition, there are studies dealing

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Data Article

Quantum computational, spectroscopic and molecular docking studies of 5,5-dimethylhydantoin and its bromine and chlorine derivatives

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Keywords:
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NLO
Molecular docking

ABSTRACT

Quantum computational and spectroscopic studies are very much essential to study the molecular structure, functional group present, quantum level properties, and applications of organic compounds. In this research experimental spectroscopic studies like FT-Raman, FT-IR, UV–Visible, and density functional theory (DFT) approach are followed on the bromine and chlorine derivatives of 5,5-dimethylhydantoin. The experimental results of FT-IR, FT-Raman, and UV–Vis are compared with the theoretical calculations like density functional theory with the B3LYP method and 6–311++G(d,p) basis set. The optimized molecular geometry of the two derivatives is carried out compared with the experimental studies. The vibrational assignments and potential energy distribution were reported. This work also provides the non-linear optical properties. The stability and reactive nature of the compounds were calculated by natural bond orbital analysis. The bonding nature and bond energies are computed by atoms in a molecule theory. The electronic properties like HOMO- LUMO and various other chemical properties are obtained using B3LYP and also CAM-B3LYP methods with 6–311++G(d,p) basis set. By using the UV–Vis experimental studies and time-dependent theoretical studies the maximum absorption wavelength, bandgap, and transition assignments were carried out with different solvents. The reactive areas of the bromine and chlorine derivatives were obtained using molecular electrostatic potential and Fukui function studies. The ligand and protein interactions are computed by molecular docking to identify the drug activities.

Specification Table

Subject area	Computational Chemistry and Spectroscopy
Compounds	bromine and chlorine derivatives of 5,5-dimethylhydantoin
Data category	Computational simulations, Molecular dynamics, spectroscopy and docking
Data acquisition format	FT-IR, FT-Raman, UV–Vis and DFT-B3LYP
Data type	Analyzed; Experimental and Theoretical
Procedure	Experimental and theoretical comparison
Data accessibility	With this article

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Bimetallic PtCu-decorated reduced graphene oxide (RGO)-TiO_2 nanocomposite for efficient oxygen reduction reaction

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Oxygen reduction reaction (ORR)

ABSTRACT

To exploit the full advantages of electrocatalysts for fuel cell reactions, a promising support is essential to disperse electrocatalytically active metal nanoparticles. Here, at first a graphene oxide-titanium dioxide composite support (GO-TiO_2) is fabricated by a sol–gel method. Later, a facile chemical reduction method is demonstrated to simultaneously reduce Pt^{4+}, Cu^{2+} and GO-TiO_2 to form bimetallic PtCu nanoparticles (15 wt% Pt + 5 wt% Cu) on a reduced graphene oxide-titanium dioxide (RGO-TiO_2) composite support. A combined action of ethylene glycol and ascorbic acid play a positive role in attaining well dispersed PtCu with a size of 7 nm particles on RGO-TiO_2 sheets. The resulting PtCu/RGO-TiO_2 nanocomposite exhibits superior electrode-area normalized ORR limiting current density (6.14 mA/cm^2-geo) when compared to commercial Pt/C (3.61 mA/cm^2-geo) and in-house synthesized PtCu/RGO (4.68 mA/cm^2-geo) and Pt/RGO (3.95 mA/cm^2-geo) catalysts. The synthesized catalysts are characterized for structural, morphological and surface elemental features by using a combination of diffraction, spectroscopy and electron microscopy techniques. The positive role played by PtCu and RGO-TiO_2 composite support assists the improved ORR activity. The versatile synthesis methodology presented here is convenient to fabricate other similar electrocatalytic nanostructures for fuel cell reactions.

1. Introduction

Increased depletion of fossil-based fuels and humanity's raising concerns towards sustainable environment put great demand on the researchers to look for eco-friendly energy resources [1,2]. Usage of hydrogen as a flexible and convenient energy carrier is considered to be the most promising substitute for fossil fuels [3]. In this regard, hydrogen-fed proton exchange membrane fuel cells (H_2-fed PEMFCs) that directly convert chemical energy of fuel into electricity without any harmful products has been presented as one of the most promising sustainable energy technologies [4]. Unfortunately, ORR kinetics is not at desirable level for the efficiency of PEMFC [5]. Platinum-based materials are widely explored as the most efficient electrocatalysts to accelerate ORR in PEMFCs [6–8]. However, the expensive price and limited source of platinum hinders its practical usage in PEMFCs. Therefore, intense efforts have been made to develop low-cost catalysts to replace Pt or to decrease the weight percentage of Pt. Alternatively, metallic non-noble catalysts have been widely developed for electrocatalytic ORR applications; however, their activity as well as the durability is still far below than established Pt-based catalysts [9–12]. Specifically, in order to accelerate the kinetics of ORR at practical level in PEMFCs, the development of cathode catalysts cost and durability issues as well as sluggish kinetics of ORR need to be addressed. Many interesting studies have been reported towards the enhancement of ORR kinetics [13,14]. Impressively, utilization of metal oxide structures as support to disperse metal nanoparticles gained significant interest in electrocatalysis research considering the overall stability of the catalyst. In particular, nanosized TiO_2 has been utilized as a conductive support for dispersing metallic nanoparticles (Pt, Pd, Au etc.) because of their higher stability than carbon-based materials [15,16]. Although, exceptional stabilities are achieved with metal oxide-based supports, however, they generally lack required electrical conductivity, making them less preferred materials for electrocatalysis applications [17,18]. It is therefore desirable to develop a good electrocatalyst support material with required properties such as high surface area for catalyst particle dispersion, sufficient electronic conductivity to transport electron during ORR, and good electrochemical stability in acidic or alkaline conditions.

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Debris collection in water using purification techniques: A review

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ABSTRACT

In earth for living organisms' water is a significant source for surveying, and it is natural resources. Water covers most of our earth, and it is approximately 98% of water is seawater and is unusual for drinking. As clean (i.e. freshwater) water becomes rarer, a new invention offers hope, with the potential to clean up polluted waterways and make them suitable for drinking once again. To do this, we have two techniques that are implementing nowadays. These include Water cleaner robot and River water treatment plant. The Watcleaner is a robot, which floats on the surface of the water and automatically filters the oil, trash and other pollutants. It can detect the fish, dolphins, and all living organs which are in the water, making sure that none harmed during the cleaning process. Whereas the treatment plant removes microbiological, chemicals and radiological contaminants through four stages, ultra-filtration treatment, process stages include coagulation, clarification membrane filtration granular activated carbon- filtration and chlorine treatment. But by implementing Watcleaner, some disadvantages arise, i.e. the garbage is collected by the Watcleaner and sent it to disintegrators, and it stores for a long time, and it causes pollution again. To overcome the problem, nano bytes into the disintegrators and dissolve the garbage instantly. Whereas the River water treatment plant requires more space and large equipment, but it works efficiently than Watcleaner. In Watcleaner, instead of using power generators, replace them with solar panels and batteries can save power. Also, the Global Positioning System tracking systems helps to track the exact location.

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Automated detection system for texture feature based classification on different image datasets using S-transform

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Abstract
The objective of this study is to present a computer-aided diagnosis (CAD) system for automatic detection of brain tumors in brain magnetic resonance (MR) image data sets as we consider the brain image dataset from the different datasets. The proposed system initially pre-processes the input images using Fuzzy C-means (FCM) for image segmentation. Subsequently, it utilizes variant of S-transform namely discrete orthonormal S-transform (DOST) to extract the texture features and its dimensionality is reduced using Principal component analysis (PCA) and linear discriminant analysis (LDA). The reduced features are then supplied to the proposed Adaboost algorithm with Random Forest (ADBRF) classifier where the random forest is used as the base classifier for classifying the abnormal brain tumors in MRI image datasets. The simulation results based on the five runs of k-fold stratified cross-validation indicate that the proposed method yields superior accuracy (98.26%) as compared to existing schemes.

Keywords Discrete orthonormal S-transform (DOST) · Linear discriminant analysis (LDA) · Adaboost Random Forest (ADBRF)

1 Introduction

Cancer has been a great threat to mankind since last few decades. Medical Fraternity, Scientists and Researchers have not only worked on curing this menace but are focusing on early detection so that the medical fraternity and patients have enough time to counter this and nip the disease in the bud. Brain is one of the most complex organs in the human body that works with billions of cells. A brain tumor arises when there is uncontrolled division of cells forming an abnormal group of cells around or inside the brain. That group of cells can affect the normal functionality of the brain activity and destroy the healthy cells (Kavitha et al. 2016; Christ and Parvathi 2012). Brain tumors classified to benign or low-grade (grade I and II) and malignant tumors or high-grade (grade III and IV). Benign tumors are nonprogressive (non-cancerous) so considered to be less aggressive, they originated in the brain and grows slowly; also it cannot spread to anywhere else in the body. However, malignant tumors are cancerous and grow rapidly with undefined boundaries. They can be originated in the brain itself which called primary malignant tumor or to be originated elsewhere in the body and spread to the brain which called secondary malignant tumor (Khambhata and Panchal 2016; Kaur and Rani 2016; Das and Rajan 2016). Brain magnetic resonance imaging (MRI) is one of the best imaging techniques that researchers relied on for detecting the brain tumors and modeling of the tumor progression in both the detection and the treatment phases. MRI images have a big impact in the automatic medical image analysis field for its ability to provide a lot of information about the brain structure and abnormalities within the brain tissues due to the high resolution of the images (Zacharaki et al. 2009; Litjens et al. 2017; Singh et al. 2012). In fact, Researchers presented different automated approaches for brain tumors detection and type classification using brain MRI images since it became possible to scan and load medical images to the computer. The contributions of this paper is applying the machine learning concept to computer-aided diagnosis (CAD) system for automatic

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Optimal distributed control of renewable energy-based microgrid – an energy management approach

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ABSTRACT

This article proposes an optimal control for renewable energy-based microgrid. The proposed microgrid is composed of the solar photovoltaic systems (SPV), battery energy storage system (BESS) at bus-1 which is then interconnected to another SPV with BESS system and with some intermittent loads. The power obtained from the SPV is operated with maximum power point tracking algorithm. The excess power will be delivered by the battery. The battery is operated in the bi-directional mode, i.e. charging and discharging mode depending upon the power level from SPV. The two systems are operated in a distributed control approach. The disadvantages in the centralised and decentralised control approach can be overcome by the distributed control and these sources are operated in an optimal power flow with a slide mode control. The proposed system has been executed on Matlab/Simulink platform and its results have been explored. Thus obtained results show the effectiveness of the proposed scheme.

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KEYWORDS
Distributed control; sliding mode control; microgrid; renewable energy systems

1. Introduction

The important drawback of the existing centralised power generating stations, such as thermal power-generating units and hydel power-generating units, has a considerable effect on the environment. Furthermore, it is exhaustive in nature and non-renewable. Also, huge power loss can occur in load centres from generating stations. Hence, on-site power generation is highly appreciated. Hence, alternatives sources, such as solar photovoltaic systems, wind energy systems, fuel cell-based energy systems, etc., for conventional sources are considered to be distributed sources which are renewable in nature. With the advancement of technology, focus on distributed generation (DG) is increased instead of centralised generations (Schiffer et al. 2016). The enormously increasing energy demands can be met with the combination of centralised power-generating units and distributed energy sources such as photovoltaic arrays, wind power, fuel cells, along with energy-storing devices such as batteries and capacitors. Apart from meeting energy demand, we can reduce carbon emission with this distributed energy generation (Guo et al. 2015). Apart from its intermittent nature and large penetration of the renewable energy generation, DG faces technical problems related to its connection to other distributed networks and the main grid. Here, the concept of microgrid is introduced to address these issues.

The microgrid looks promising to meet the future demands, as it can cope up with quick dynamics in load demand, decreasing transmission losses while maintaining reliability and flexibility. The concept of microgrid is getting so much attention now as it can able to take care of the critical loads of the main grid in the event of failure of the grid along with its local loads by utilising renewable resources. Also they can be able to operate autonomously in the event of grid failure and can supply energy to its local loads (Sadabadi, Shafiee, and Karimi 2017; Rey et al. 2017; Xin et al. 2015; Han et al. 2018; Nasirian et al. 2015; Zamora and Srivastava 2018; Li et al. 2018; Baghaee, Mirsalim, and Gharehpetian 2018; Parisio, Rikos, and Glielmo 2014; Wang et al. 2019; He et al. 2018; Pahasa and Ngamroo 2016; Ouammi, Dagdougui, and Sacile 2015). The microgrid can operate in two modes: grid-connected mode and islanded (autonomous) mode. To understand the importance of renewable energy-based DG and its integration, a basic comparison between a conventional power grid and a microgrid is presented in Table 1.

Following the standards of the consortium for electric reliability technology solutions (CERTS) architecture (Wang, Jin, and Wang 2018), (Tucci et al. 2016), a basic microgrid is an interconnection of

(1) Distributed generating (DG) units such as photovoltaic energy, wind power and fuel cells, and microturbines.
(2) Storage devices such as batteries, capacitors and flywheels for integration purpose,
(3) Group of feeders for distribution and
(4) Energy management system for managing power dispatching and set point setting to each DG unit controller.

The scheme of the microgrid is shown in Figure 1.

2. Microgrid components

Microgrid consists of microsources, i.e. distributed generating units, storage devices and interfacing components, loads which

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Quantum computational, spectroscopic investigations on 6-aminobenzimidazole by DFT/TD-DFT with different solvents and molecular docking studies

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ABSTRACT

Quantum chemical density functional theory approach (DFT) and vibrational spectroscopy investigation were done on one of the benzimidazole derivatives called 6-Aminobenzimidazole (6ABM). The B3LYP method and 6–311++G (d,p) basis set were used to get the optimized structure, vibrational frequencies, and other various parameters. Atoms in molecules theory were employed to find the binding energies, ellipticity and isosurface projection by electron localization function. The various functional groups are identified using FT-IR, FT-Raman and NMR spectra and compared with the scaled value of simulated spectra. The donor and acceptor interactions are studied by NBO analysis. The reactive areas of the molecule are obtained by molecular electrostatic potential (MEP) and Fukui functions. By using the UV–Vis spectrum the maximum absorption wavelength was obtained and compared with TD-DFT/PCM method with different solvents. The biological studies like drug-likeness and molecular docking are carried out on the molecule.

1. Introduction

A heterocyclic compound is a cyclic compound and member of its rings has atoms of two different elements [1–4]. Nucleic acids, natural and synthetic dyes and the majority of drugs are heterocyclic compounds. Heterocyclic ring systems are obtained by joining with other rings of carbocyclic or heterocyclic called benzimidazole. The substituted imidazole derivatives are valuable in the treatment of many fungal infections. These derivatives easily interact with DNA and RNA. So it inhibits the growth of bacterias and fungal infections having good antifungal and antitumor activities [5–9]. The above literature studies confirm that the benzimidazole derivatives were good antifungal activities and one of the benzimidazole derivatives is 6-aminobenzimidazole (6ABM). Presently quantum chemical theory, density functional theory, molecular modeling, and vibrational spectroscopy are playing a major role in the drug research and development. Since the functions of the compounds or drugs depend on the structure, functional group, biological and other physiochemical parameters. Literature survey shows that there were no quantum chemical and molecular modeling studies done on this molecule 6ABM. In order to understand the structure and functions of 6ABM in quantum level, a quantum mechanical concept called density functional theory followed. The optimized geometry and vibrational frequencies are compared with experimental FT-Raman, FT-IR, NMR, and UV–Vis spectra. By natural bond orbital analysis (NBO) the intermolecular interactions and the stability of 6ABM are obtained. The HOMO and LUMO calculation give the stability and hard and soft nature of the compound. By measuring the maximum absorption wavelength from 6ABM by DMSO and Methanol solvents by PCM model the electron transitions are obtained. The reactive area of the molecule is obtained qualitative by Molecular Electrostatic Potential and quantitatively by Fukui function analysis. The effect of temperature on the compound and its thermodynamic parameters entropy, enthalpy, and heat capacity are analyzed. To get the drug properties of the compound, drug-likeness and ADME studies are conducted on the 6ABM and its derivatives having antifungal properties.

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Analysis and design of a robust controller for a grid-connected photovoltaic power plant

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ABSTRACT

Application of renewable energy systems has a drastic impact on the present power system. In particular, solar photovoltaic power generation is expanding exponentially. Hence, in this article analysis and design of a 1 Mega Watt (1 MW) solar power plant has been modelled. The obtained power is given as an input to the voltage source converter, which contently regulates the active and reactive power by controlling the pulse width modulation signals. In this article, robust control schemes were discussed to support the required active and reactive power. Further, a detailed analysis has been presented at various fault conditions and the results are explored.

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KEYWORDS
Solar PV system; PV system; power control

1. Introduction

Nowadays, improvement in technology has brought about a drastic revolution in the power system. The increasing number of DGs and the deregulation are responsible for these revolutions in the power system. These improved technologies have allowed DGs to generate power as small scale micro sources which may take the eminence of inexhaustible renewable energy sources. The existence of these micro sources nearer to utility reduces the transmission cost and losses during transmission (Yang, Blaabjerg, and Zou 2013; Gutiérrez and Molina 2017b; Khan et al. 2017). According to consumers, the DGs not only satisfy the thermal and electrical requirements but also improve the local reliability and power availability by supplying power, thereby reducing voltage dips and decreasing the tariff of energy supply. As per the utility point, the erection of DGs is responsible for suppressing the demand for transmission and distribution services (Tarraso et al. 2017; Gutiérrez and Molina 2017a; Nelson, Martin, and Hurtt 2017). DGs can take on a supportive role in restoration of grids during faults. There are massive technical challenges that are associated with operation and controlling of DGs. During the time of disturbances in the network, it must establish balanced operation along with quality of power. So, an improvement in the control methodology of DGs to provide stable frequency along with constant voltage during randomly varying loads and unbalanced conditions of grid during faults is important (Meegahapola et al. 2017; Ghahderijani et al. 2017; Chou et al. 2017).

1.1. Challenges for distributed energy sources

In addition to the technical challenges, protection schemes are one among the major challenges for DGs during disturbances in the grid. The protection schemes must be such that they ensure better control action towards providing service to the grid by supporting its demand and taking care of the DGs. During this condition the problem may arise with sensitivity and selectivity. The conclusions concerning DGs are as follows:

- It is related to a measure of installed capacities of DGs.
- Control strategies required for grid Integration.

In general, because of irregular production of power and load variations, the operating parameters of the DGs may vary which results in in adjustment of the network topology (Lammert et al. 2017; Jones et al. 2016b). It leads to achieve economic and operational targets and reduces the loss. In these circumstances, the generic over current protection relay with a single group may be insufficient and also loss of relay-coordination may occur. So, it is best to draw the conclusion that the settings that are chosen for over current protection relay should be towards the grid topology and location along with type and magnitude of power generated. If not, unnecessary operation or failure may occur during necessary conditions (Diaz-Franco et al. 2016; Liu et al. 2016; Jones et al. 2016a). In grid-interfaced photovoltaic systems, the presence of VSI will provide the current controlling ability to maintain the required active and reactive power at the point of common coupling.

1.2. Classification of current control methods

- PWM current control methods
  - o ON/OFF controllers
    - – Hysteresis
    - – Predictive optimised technique
- Current control techniques
  - o Linear current control techniques
    - – PI (Proportional + Integral)

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Implications and implementation of Biomedical Waste Management Rules 2016 in hospitals and a common biomedical waste treatment facility in Andhra Pradesh, India

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Abstract: Biomedical waste (BMW) originated from various medical-related activities are potentially hazardous to human and animal health and poses significant threat to environment. BMW however can be rendered safe and unobjectionable, both aesthetically and environmentally if healthcare facility managers implement the appropriate requirements and recommendations of the several codes of practice and technical advice. This paper gives a brief description of the BMW Rules 2016 and the amendments thereof, the current BMW management practices in the selected health facilities in Vijayawada and a common BMW treatment facility. The case study was carried out by general survey of the facilities. It was observed that the hospitals were largely abiding to the prescribed regulations in case of collection, storage and handling the BMW. The disposal and treatment is being carried out by a proprietary firm and is in compliance with the regulatory standards.

Keywords: biomedical waste; Biomedical Waste Management Rules; treatment; disposal; regulatory standards; India.

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Reduced graphene oxide-supported Pd@Au bimetallic nano electrocatalyst for enhanced oxygen reduction reaction in alkaline media

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ABSTRACT

Rational design and synthesis of core-shell bimetallic nanoparticles with tailored structural and functional properties is highly sought to realize clean and energy-efficient fuel cell systems. Herein, Pd–Au bimetallic nanoparticles (NPs) with core-shell morphology (Pd_{Core}–Au_{Shell}) were fabricated on the surface of reduced graphene oxide (RGO) support by a facile two-step protocol. In the first step, Pd_{Core}–Ag_{Shell} bimetallic NPs were synthesized on RGO support by reducing $Pd^{2+}$and Ag^{+} ions with methyl ammonia borane (MeAB). Later, Pd_{Core}–Au_{Shell} bimetallic NPs were conveniently fabricated on RGO support via a galvanic replacement strategy involving sacrificial oxidation of metallic silver and reduction of gold ions. The resulting core/shell bimetallic NPs were characterized by X-ray diffraction (XRD), High-resolution transmission electron microscopy (HR-TEM), Energy dispersive X-ray spectroscopy (EDS), Fourier-Transform Infrared Spectroscopy (FT-IR) and cyclic voltrammetry (CV). The electrocatalytic performance of core/shell nanostructures for the room temperature oxygen reduction reaction (ORR) in alkaline media were systematically performed by CV. The electrode-area-normalized ORR activity of RGO-supported Pd_{Core}–Au_{Shell} NPs was higher than the corresponding commercially available carbon-supported Pt nanoparticles (Pt/C) at −0.8 V vs Ag/AgCl (satd. KCl) (6.24 vs 5.34 mA cm^{-2}, respectively). Further, methanol-tolerant ORR activities of as-synthesized catalysts were also studied. The Au-on-Pd/RGO bimetallic NPs presented enhanced ORR activity both in presence and in the absence of methanol in comparison with a commercial Pt/C catalyst and as-synthesized Pd/RGO and Au/RGO catalysts. The enhanced catalytic activities of core/shell structures might be resulted owing to the optimized core/shell structure comprising of a small Pd core and a thin Au shell and synergistic effects offered by Pd and Au. The present synthesis protocol demonstrated for two-layer structure can be extended to multi-layered structures with desired functions and activities.

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Chemistry SELECT Full Papers

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Facile Fabrication of Pt-Ru Nanoparticles Immobilized on Reduced Graphene Oxide Support for the Electrooxidation of Methanol and Ethanol

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This study demonstrates a convenient methodology for the decoration of Pt–Ru nanoparticles (with various morphologies like Pt-on-Ru and Ru-on-Pt) on graphene sheets. The structure, composition and morphological features of the synthesized electrocatalysts were assessed by X-ray diffraction (XRD), High-resolution transmission electron microscopy (HR-TEM), Energy dispersive X-ray spectroscopy (EDS), and cyclic voltammetry (CV). TEM analysis revealed that the Pt–Ru nanoparticles were uniformly dispersed on graphene sheets with a narrow size particle distribution. The corresponding morphology-dependent activity of electrocatalysts towards two important anodic reactions relevant to fuel cell applications like methanol oxidation reaction (MOR) and ethanol oxidation reaction (EOR) were systematically studied by CV. The results showed that Pt-on-Ru/RGO electrocatalysts exhibited higher catalytic activity and better stability compared to Ru-on-Pt/RGO, Pt/RGO and commercial Pt–Ru/C catalysts towards both MOR and EOR. Furthermore, the simple synthetic strategy demonstrated here can be extended to other bimetallic systems with improved properties for fuel cell reactions.

Introduction

Hydrogen-fed proton exchange membrane fuel cells (PEMFCs) are in the forefront of fuel conversion technologies due to their potentialities in offering high power efficiencies with lower pollutant emissions.[1] However, due to the problems associated with the storage and distribution of hydrogen, liquid fuels like methanol and ethanol have been explored as promising alternatives to hydrogen fuels.[2] To completely realize the alcohol-fed proton exchange membrane fuel cells (direct alcohol fuel cells, denoted as DAFCs) as commercially viable electrochemical energy convertors intense research efforts were focused on the development of promising electrocatalyts for both anodic alcohol (either methanol oxidation raction, MOR; or ethanol oxidation reaction, EOR) oxidation and cathodic oxygen reduction reactions (ORR).[3]

Pt-surface is the best known surface for the direct adsorption and dehydrogenation of both methanol and ethanol. Interesting nanostructured materials like Pt-nanospheres,[4] Pt-nanocages,[5] Pt-nanorods,[6] Pt-dendrites etc.,[7] were explored for electrocatalytic applications. However, CO-like species formed during the course of methanol oxidation or ethanol oxidation make Pt-alone structures impractical for real fuel cell applications. A large portion of fuel cell catalyst research is directed towards the addition of a second element along with platinum to enhance the catalyst's tolerance to CO-like species during MOR and EOR for practical fuel cell devices. Accordingly, many Pt-based bimetallics have been shown to exhibit superior activity towards oxidation of ethanol and methanol compared to Pt-alone catalysts.[8] To further improve the viability of fuel cell devices for practical applications, dedicated research efforts have also been focused on either exploring the non-platinum catalysts or retaining the usage of platinum in lower loadings with improved Pt utilization.[9]

The Pt-utilization in fuel cell electrocatalysts is believed to be improved by reducing the particle size of platinum[10] or by exploring various Pt-based bimetallic structures including core – shell,[11] textured Pt-alloys with Pt-skins on top of base metals,[12] etc. For example, Hafeez et al have demonstrated that a hydrogen-fed fuel cell incorporating Pt particles with a size of 2.3 nm as both anode and cathode exhibit an eight-fold increased mass activity compared to a fuel cell constructed with Pt particles with a size of 3.7 nm as both anode and cathode.[13] Further, homogeneous deposition of Pt-based nanoparticles on to a suitable conductive carbon supports like carbon black (CB), carbon nanotubes, graphene oxide were also explored as a convenient way to enhance the Pt utilization.[14] In addition, zeolite-based materials have been utilized along with carbon supports to improve the CO oxidation efficiencies during the electrooxidation of methanol and ethanol molecules.[15]

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strong control, and common and coordinated use of fiscal and economic instruments. The strong control on all levels (national, regional, municipal, and organizational) is a keystone for the successful use not only of Pigovian taxes and municipal fees, but also of other important and discussed policy instruments in household waste management.

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Biomedical Waste Management (BMW) practices in the Pinnamaneni Siddhartha Hospital, India – A case study

In India, the Ministry of Environment and Forests published in The Gazette of India (2016), the Bio-Medical Waste Management Rules 2016.

Andhra Pradesh (A.P.) was the first State in India to have a treatment facility for the BMW coming from the Pinnamaneni Siddhartha Hospital. The aim of this study was to focus on the analysis of its BMW management system including handling, collection, segregation, treatment and disposal. The Pinnamaneni Siddhartha (PSid) Institute of Medical Sciences and Research Foundation includes an hospital which has several specialized wards and super-specialty units, all sources of BMW with an estimated yearly quantity of 105,850 Kg.

The hospital authorities and personnel involved in BMW management were interviewed about BMW handling and management. Almost all the BMW is treated in a treatment plant situated in ChinnaKakani, in Guntur district, which serves 374 health care facilities with a total quantity of 678 kg of BMW collected, treated and disposed per day.

The collection of BMW in PSid hospital is carried out by at least two people. All the containers are labelled properly with biohazard/cytotoxic symbols and segregated according to the BMW Rules 2016 into colour coded polyethylene bags. Saline bottles are cut into two pieces to ensure no re-use in this hospital and are collected in blue colour bags. Needles are destroyed by using a needle destroyer before their disposal into the corresponding coloured bin.

The collected BMW is transported to a properly ventilated storeroom situated in the hospital campus but away from the medical units for no more than 24 h. From here it is transported to the treatment/disposal facility. The treatment of BMW from PSid is carried out through on-site and off-site methods.

On-site methods are chemical disinfection of plastic wastes using chlorine solution and needles destruction. The waste is then segregated according to the suitable treatment or disposal option. BMW categories under Yellow code are treated by incineration, red code waste is treated by autoclaving, plastic and sharp wastes are shredded. The recyclable plastic is collected by Authorized Plastic Collector of Andhra Pradesh Pollution Control Board (APPCB). The ultimate disposal is landfilling into concrete pits of 20 ft. depth located nearby the treatment facility. The wastewater generated from the incineration or autoclaving is treated in an effluent treatment plant (ETP). The incinerator complies with the emission standards (Table 1).

SAFE-ENV also conducts workshops and seminars to achieve awareness and submits annual report consisting of information on collected BMW, quantities and treatment.

Table 1
BMW treatment techniques and their compliance with Rules at SAFE-ENV.

Treatment	Parameters	Operation/emission standards maintained in SAFE-ENV	Operation/emission standards as per Schedule II of BMW Rules 2016	Remarks
Incinerator	Temperature in primary chamber	800 ± 50 °C	800 ± 50 °C	In compliance
	Temperature in secondary chamber	1050 ± 50 °C	1050 ± 50 °C	In compliance
	Chimney height	30.48 m	30 m	In compliance
	Suspended particulate matter	115 mg/N m^3	50 mg/N m^3	In compliance as per BMW Rules 2011 whose standard is 150 mg/N m^3
	Nitrogen oxides	80 mg/N m^3	400 mg/N m^3	In compliance
	Sulfur oxides	80 mg/N m^3	450 mg/N m^3	In compliance
	Incinerator shell thickness	6 mm mild steel	Atleast 5 mm mild steel	In compliance
Gravity type autoclave	Temperature	120 °C	121 °C	In compliance
	Residence time	60 min	Not less than 60 min	In compliance
ETP	pH	5.0–9.0	6.5–9.0	The lower pH value in the given range is higher than that maintained
	Total suspended solids	200 mg/L	100 mg/L	Two times higher value
	COD	250 mg/L	250 mg/L	In compliance
	BOD	100 mg/L	30 mg/L	High BOD
	Oil and grease	10 mg/L	10 mg/L	In compliance

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Waste pickers and environmental conservation

Islamabad with a population 1.83 million generates an estimated amount of 800 tons of solid waste per day. Directorate of sanitation working under the Capital Development Authority (CDA) is responsible for solid waste collection residential transportation and safe disposal within the capital territory. Only an estimated amount of 600 tons of solid waste is collected per day (Nisar et al., 2008; Mahar et al., 2006). Besides the formal collection by CDA employees, solid waste is also collected informally in the city. These scavengers collect recyclable items, from the road sides, commercial markets/areas and from the household waste. Most of the scavengers are non-native resident and come from Punjab and Khyber Pakhtunkhwa. Most of them (72%) are illiterate and some have a basic level of education. Their age ranges between 20 and 40 years but there are also some children (28%).

This research study investigated the problems faced by the waste pickers and their contribution in conservation of natural resources from the actors' perspective. It also investigated socio-economic and health conditions of the scavengers. A survey from 190 waste pickers was conducted by using purposive sampling in order to cover the residential, commercial and rural parts of the capital city, and the data were analysed with Statistical Package for Social Scientist (SPSS).

Scavenging is an emerging informal economy that not only provides survival opportunity to the individuals but also gives chances to earn some money which, however, are not enough for living. This study reveals that the majority (43%) of the respondents were engaged in household's waste collection in the city. They segregate recyclable items and sell them. The remaining organic material is thrown into a designated container and, successively, transported to a dump site. The 87% of the respondents segregate collected items before selling to the *kabaria* or *thaikeydar* (vendor). A 39% of the respondents' segregate material during collection and 25% of the respondents segregate collected material at the selling point. The reason behind segregation is that each already segregated item has a higher value.

The 74% of the respondents were satisfied with their work. A significant majority (55%) of the scavengers was happy with his work because waste picking is an easy way to earn money without investment or skills. The 26% of the respondents who was not satisfied with the work considers collection of solid waste as a dirty work and they are not well-seen by other Pakistan people. The 96% of the respondents do not take safety measures. Some of them had injuries with infected syringes or other sharp edges materials. There is the need to provide scavengers with safety knowledge, skills and health care facilities.

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Ultrafine Pt–Ru bimetallic nanoparticles anchored on reduced graphene oxide sheets as highly active electrocatalysts for methanol oxidation

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The controlled fabrication of bimetallic nanocatalysts with a suitable size, structure and morphology is extremely important to realize direct methanol fuel cells (DMFCs) as promising energy-generating sources. In this paper, a facile approach for depositing platinum–ruthenium (Pt–Ru) bimetallic nanoparticles on a reduced graphene oxide (RGO) support has been demonstrated. Two electrocatalysts denoted as Pt–Ru/RGO-AA and Pt–Ru/RGO-AB were synthesized by synchronously reducing H_2PtCl_6 and $RuCl_3$ on the graphene oxide (GO) support with reducing agents ascorbic acid and methyl ammonia borane, respectively. For comparison of methanol electrooxidation activity, monometallic Pt nanoparticles supported on RGO sheets (Pt/RGO) were also synthesized. All the catalysts were conveniently synthesized under ambient conditions without using any surfactants. The Pt/RGO, Pt–Ru/RGO-AA and Pt–Ru/RGO-AB electrocatalysts were characterized using X-ray diffraction (XRD), high-resolution transmission electron microscopy (HR-TEM), selected area electron diffraction (SAED) and energy dispersive X-ray spectroscopy (EDS). Among all the catalysts, the Pt–Ru/RGO-AB catalyst with an average particle size of 2.8 nm possessed remarkable uniformity on the RGO sheets. The electrochemical performance of RGO-supported Pt and Pt–Ru catalysts towards methanol oxidation was systematically studied using cyclic voltammetry and chronoamperometry. The results demonstrate that the Pt–Ru/RGO-AB catalyst with a high electrochemical active surface area (ECSA) of 130.46 $m^2\ g^{-1}$ exhibits a higher mass and ECSA normalized activities towards methanol oxidation. Furthermore, the Pt–Ru/RGO-AB catalyst has a better tolerance towards accumulated CO-like species as realized from its higher ratio of forward peak current density to reverse peak current density (I_f/I_b) of 3.21. The facile fabrication strategy described here is convenient and could be used for the fabrication of other multi-component nanostructured electrocatalysts for fuel cell reactions.

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Introduction

Direct methanol fuel cells (DMFCs) have become a subject of extensive research due to their ability to offer environmentally friendly energy conversion with a high efficiency and promising durability.[1–3] In these electrochemical cells, methanol and water molecules are simultaneously oxidized at the anode producing CO_2, electrons and protons (known as the methanol oxidation reaction, MOR). Protons released at the anode diffuse through the proton exchange membrane to the cathode and react with electrons and the oxidant air simultaneously and are reduced to water (known as the oxygen reduction reaction, ORR). The direct oxidation of methanol fuel simplifies the fuel-cell technology and attracts applications in various power-hungry portable devices like cellular phones, notebooks and computers. With more recent developments in this field, fuel cells are promising to provide power to automobiles and in large scale electricity-generating set-ups.[4] The key to realize the widespread use of DMFCs for mobile and stationary applications is the use of more efficient and stable electrocatalysts which can effectively catalyze both MOR and ORR half-cell reactions. In particular, the development of sufficiently active and selective catalysts to accelerate the kinetics of MOR is a prerequisite for further progress of this technology. So far, platinum is the only metal available for the dissociative adsorption of methanol. However, methanol oxidation produces carbon monoxide and

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PREPARATION OF HIGH-PURITY ULTRAFINE COPPER POWDER IN MASS-PRODUCTION BY CHEMICAL REDUCTION METHOD: TAGUCHI ROBUST DESIGN OPTIMIZATION

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The Taguchi robust design method is implemented for the optimization of experimental conditions in the synthesis of high-purity ultrafine copper powder (HUCP) in mass-production by the chemical reduction method. A reducing agent, reaction temperature, reducing agent weight, and a stirring rate are chosen as the major optimization factors and the conversion rate, particle size, and reaction time are chosen as the desired targets. It is established that the reducing agent and the reaction temperature are the most significant factors that affect the desired targets. Among the selected or designed factors, the optimal conditions for producing the HUCP are: $NaH_2PO_2 \cdot H_2O$ as the reducing agent (level 2), temperature 70°C (level 3), a reducing agent weight of 8.14 kg (level 3), and a stirring rate 300 rpm (level 2). The study results for the three desired targets are in agreement with the prediction made by the Taguchi method. Furthermore, the pure (impurity <0.06%) face-centered cubic structure of the HUCP with 1.51 μm average particle size is extensively characterized and determined by inductively coupled plasma–optical emission spectrometer (ICP–OES), laser particle-size analyzer (DLS), scanning electron microscopy (SEM), and X-ray diffraction (XRD) analysis. This surfactant-free facility method is suitable for the synthesis of high-purity ultrafine copper powder by mass-production method.

Keywords: *ultrafine copper powder, chemical reduction, Taguchi design, optimization*

INTRODUCTION

Ultrafine powders have been very well utilized in recent decades. Numerous ultrafine-scale materials with different properties have been synthesized from bulk materials. Specifically, a high-purity ultrafine copper powder (HUCP) is obtained from a common metal that has been under continuous investigation. The conductivity, heat transfer, and the price (lower than that of precious metals) has increased the awareness for investigation. The size-related properties of ultrafine powders influence their application in many fields, such as materials, chemistry, electronics, optics, and biology [1–4].

Copper metal powders are generally prepared by: microemulsion [5], reverse micelles [6], reduction of aqueous copper salts [7], *g*-irradiation [8], UV-light irradiation [9], and polyol process [10]. The HUCP can be

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