E-Proceedings

International Virtual Conference on

Frontiers in Manufacturing Technology (FMT 2020)

13th - 14th October, 2020

Organized by:
Department of Physics, School of Applied Sciences,
Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University
Institute of Eminence (IOE)
Bhubaneswar-751024, Odisha

Message

It is my pleasure to note that Department of Physics, School of Applied Sciences, KIIT Deemed to be University, Bhubaneswar is oraganising an International Virtual Conference on Frontiers in Manufacturing Technology (FMT 2020) from 13th to 14th October 2020.

KIIT Deemed to be University has been actively promoting Science and Research for the welfare of the society since its inception. The theme of this conference is very much relevant in the present scenario when the whole world is fighting and trying to recover from the Covid-19 pandemic.

I hope this conference on Manufacturing Technology will provide a platform that will motivate all the researchers and industry leaders across the globe towards the goal of **'Atmanirbhar Bharat'** (Selfreliant India).

My anticipation is that this conference would certainly induce innovative ideas among the participants paving way for development in new technologies and thereby inventions that would benefit the society as a whole.

I congratulate the organizers for arranging such an extraordinary event, even during the pandemic situation. I convey my best wishes to all participants across world and extend my wishes for the grand success of the conference.

(Dr. A. Samanta)
Founder, KIIT & KISS

Message

It is my pleasure to share a few words for International Virtual Conference on Frontiers in Manufacturing Technology (FMT 2020) that is organized by Department of Physics, School of Applied Sciences, KIIT DU, Bhubaneswar from 13th to 14th October, 2020.

Conferences are necessary to bring the culture of information exchange and discussion on developing trends in technologies. New technologies cannot be generated without research and developmental activities. Such events promote scientific temper among young researchers, scientists, academicians and industrialists.

I hope this International Conference on 'Frontiers in Manufacturing Technology' not only brings all the researchers and industrialists at a platform but it also inculcates the research culture among the entire fraternity internationally, thereby, contributing to the development of society.

I am confident that this conference would induce innovative ideas among the participants paving way for new invention and technologies in the field of various Manufacturing Technologies. It will also trigger interactions among researchers to exchange the scientific ideas among themselves.

I congratulate the organizers for arranging such an extraordinary event at this point of time. I convey my best wishes to all participants across world and extend my wishes for the success of the conference.

Prof. Hrushikesha Mohanty
Vice-Chancellor,
KIIT-Deemed to be University

सीमेट
CMET

Dr. B. B. Kale
Director

सेन्टर फॉर मटिरियल्स फॉर इलेक्ट्रॉनिक्स टेक्नोलॉजी
(वैज्ञानिक संस्था, इलेक्ट्रॉनिकी और सूचना प्रौद्योगिकी मंत्रालय, भारत सरकार)
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Message

At the opening of conference it gives me great pleasure to send you sincere message of support and good wishes. I can say that nothing is more important in the present world than the striving for the common good which find expression in the honest collaboration among individuals as well as organization.

Bharat Kale

(Dr. Bharat B. Kale)
Director General (A) / Director (A)

Message

I am glad to know that Department of Physics, School of Applied Sciences, KIIT Deemed to be University, Bhubaneswar is organizing an International Virtual Conference on "Frontiers in Manufacturing Technology (FMT 2020)" on 13th and 14th October, 2020.

The theme of the conference is of wide research interests that can benefit the world starting from the energy sector to increasing life expectancy. This platform will nurture young minds towards scientific development in the field and its implementation. Academics jointly with industries can do wonders in the field of research and development and this conference will provide such a stage for collaborative efforts.

I extend my greetings and congratulations to the organizers and the participants and wish the Conference all success.

Prof. Sasmita Samanta
Pro-V ice Chancellor,
KIIT-Deemed to be University

Message

It gives me immense pleasure to note that the Department of Physics, School of Applied Sciences, is going to organize an International Virtual Conference on "Frontiers in Manufacturing Technology" (FMT 2020) October 13-14, 2020.

I came to know in this Conference more than ten well-known Director/ Chairman/ Managing Directors of different Industries/Academia are speaking to the participants. I hope this conference will provides a platform to exchange knowledge about the latest scientific and industry results and to discuss the latest trends and development in area of advanced applied physics for the development of humanity at large.

KIIT Deemed to be University has always played a vital role in promoting and organizing various value adding activities of curricular and co-curricular programs, even today when the whole world is suffering from the COVID-19 pandemic, we at KIIT Deemed to be University envisions to enrich education. I extend my best wishes to all participants for a grand success of this conference and congratulate the team for their excellent endeavour.

Wishing the team, all success.

Prof. Jnyana Ranjan Mohanty
Registrar,
KIIT-Deemed to be University

Message

Ii is a pleasure to know that the Physics wing of the School is organizing an International conference "Frontiers of Manufacturing Technology (FMT 2020)" during 13 - 14 October 2020.

This meet of scientists, academicians, Industry personnel, young researchers and students from allied disciplines is very crucial to solve many different challenges of Manufacturing and allied sectors including the Science involved. Complex challenges often require different perspectives, cutting across disciplines and expertise. It is also very important to frame suitable platform for the next generation to be systematically inducted into the scientific workforce. In this context, it is much desirable that the deliberations during the two day event shall lead to smart outcomes for a wide range of stakeholders.

I take this opportunity to congratulate the organizing team of this important event and wish the conference a grand success.

Dr. Puspalata Pattojoshi
Dean SAS,
KIIT-Deemed to be University

Message

It is my privilege to be Co-convener for International Virtual Conference on Frontiers in Manufacturing Technology (FMT – 2020), organized by Department of Physics, School of Applied Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, India. I congratulate all the organizing committee members who put forward such as thoughtful conference, bringing experts from both industry & academia on a united international platform. It's a fantastic and positive initiation.

I strongly believe the progress of science and technology is key for the benefit and progressive development of mankind. Such progress of science and technology is possible with sharing of knowledge and experience. In the present time, science and technology has become highly multidisciplinary and it is important to collaborate research activities of various disciplines. For example, Industry 4.0 focuses heavily on interconnectivity, automation, machine learning, and real-time data. Industry 4.0 combines physical production and operations with smart digital technology, machine learning, and big data to create a more holistic and better-connected ecosystem. FMT-2020 is an enabler, which enabled the collaboration between industry and academia of multidisciplinary fields with a collective focus on tomorrows manufacturing technology. I am confident that the discussions and deliberations opened new opportunities of research and applications in manufacturing technology and help to drive the country towards Atmanirbhar Bharat (Self- Reliant India)

At the outset, I take this opportunity to thank all the patrons, organizers and participants who came forward irrespective of their busy schedule and made this conference a big success.

Jai Hind

Dr. Venugopal Thota
Managing Director
Welding Alloys (Far East) – Malaysia
Welding Alloys South Asia - India

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Message

It gives me pleasure that the Department of Physics, SAS, KIIT Deemed to be University, Bhubaneswar is organizing International Virtual Conference on Frontiers in Manufacturing Technology (FMT – 2020).

It is my privilege and honor to serve as Organizing Secretary for FMT 2020. With its visionary thought process, KIIT Deemed to be University has always been innovative in approach for empowerment of students and society with trendsetting curricular and co-curricular activities. In this era of technological revolution, I strongly believe that to foster economic and social development there should be a set of interactions between academia (the university), industry and research Institutes (government). This set of interaction model is popularly known as "Triple helix model of Innovation".

I congratulate the organizers and KIIT Deemed to be University for initiating this Triple helix model of Innovation through FMT-2020. I strongly believe that this kind of initiative will catapult the thought process of co-ordination between Industry, Academia and Research Institutes (Government) which would eventually translate into **"AtmaNirbhar"** Bharat.

I wish the organizers of the FMT 2020 and the participants a grand success

RL Sharma

Rajendrakumar Sharma

Message

I am happy to know that International Virtual Conference on Frontiers in Manufacturing Technology (FMT 2020) is going to be organized by Department of Physics, School of Applied Sciences, KIIT DU, Bhubaneswar from 13th to 14th October, 2020.

New scientific and technological ideas are always generated with the help of researchers and scientist. It is time for researchers and scientists to understand the need of time and join hands together for R and D activities and its conversion into commercialization.

Organizing such an event at this pandemic situation when the whole world is fighting from Covid 19, reinforces our objective of developing an environment for the exchange of ideas towards technological developments. I hope the deliberations and discussion in this International conference FMT 2020 will certainly open new dimensions regrading awareness and opening a new job opportunities in technical and industrial sectors to make Atmanirbhar Bharat

Dr. S. K. S. Parashar
Convener
SAS, KIIT-Deemed to be University

PL-01

Rechargeable batteries and materials as an energy storage device

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Abstract- Batteries are characterized by high specific energy, high efficiency and long life. These unique properties have made lithium batteries the power sources of choice for the consumer electronics market with a production of the order of billions of units per year. These batteries are also expected to find a prominent role as ideal electrochemical storage systems in renewable energy plants, as well as power systems for sustainable vehicles, such as hybrid and electric vehicles.

At the same time Na being a cheaper the research has also been focussed to develop Na-ion batteries. These batteries will be much cheaper and will have comparable capacity. In future, flexible electronics will be very popular and hence flexible batteries will have also significance.

The performance of the battery is depend on the chemistry of materials. The capacity is decided by the materials composition and structure. Hence, materials research is playing major role in battery technologies. C-MET is working in this area and established the fabrication facility and battery chemistries.

PL-02

SUPERCAPACITORS….an Emerging energy storage technology of future

Rajendrakumar Sharma
Chairman & Managing Director,Spel Technologies Pvt. Ltd, Pune, India

Abstract- Growing concerns about the environmental impacts of fossil fuels, thrust on adoption of Electric mobility, push for development and utilization of large-scale renewable energies like Solar and wind, and with the development of smart grid, supported by investment and government policies, the prospect of energy storage application has gone up multifold. Potential applications of Energy Storage could be found in the entire spectrum of power systems such as generation, transmission, distribution, and utilization.

Energy storage is not new. Batteries have been used since the early 1800s, and the rapid development of energy storage technology and it's commercialization has created significant impact on power system in terms of future system model. Modern electronic devices/gadgets have developed at extremely high pace, but energy storage devices have not been able to keep pace with these Power-Hungry devices/gadgets.

These Power-Hungry devices/gadgets and Electric mobility uses Lithium Ion batteries for their needs. These modern devices have's good appetite for Power density as well as Energy density. Both of this requirement is sufficed by batteries. It is known fact that batteries are good at energy density, but battery gets adversely affected while honoring power density requirement of load. Batteries are energy dense devices, but they lag in power density. For power density application Supercapacitors are best candidate.

Supercapacitors are environment friendly, 20 times more power dense than batteries, can be charged in seconds, safe device, over 100,000 charge discharge cycle life, and wider temperature operating range. With recent development in Supercapacitor technology, advancement in materials and reduction in cost of materials, Supercapacitors are fast catching up, and can potentially bridge the gap for critical commercial applications.

Casual overview of these two technologies Batteries and Supercapacitors may give impression that these are competing technologies, but the fact remains that they are complementing technologies. In fact, the development/research trends in these two technologies translates that in quest of further development/advancements batteries wants to inherit supercapacitor capabilities, and supercapacitors want to inherit battery capabilities. This trend is indicative of is converging technology.

Hybrid power pack module consisting of Supercapacitors + Batteries in complimenting mode have shown promising/encouraging results……

Hybrid Supercapacitors with energy density around 22 Wh/kg is catching up. Graphene variant of Supercapacitors is also under development……..

Recovery of alumina, silica and rare earth values from Indian fly ash

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Abstract- Fly ash is generated as a solid waste in huge quantities during power generation in coal-based power plants. Currently, the worldwide generation of fly ash is about 800 million tons per annum out of which India alone produces 180 million tons per annum since 70% of total power generation in India is based on thermal power plants. For storing such a huge quantity of fly ash, the requirement of land space will be enormous. On the other hand, the disposal of fly ash would create environmental concern and can be hazardous to mankind. Due to dumping of fly ash, every year about 45 million tons of alumina, the most valuable material present in fly ash is getting accumulated as waste. Therefore, researchers have started focusing on the development of a suitable technology for the recovery of alumina from fly ash. However, recovery of alumina from fly ash is one of the most challenging tasks in the field of metallurgy. So far no viable option for the treatment of fly ash is available particularly when alumina content is around 25%.

CSIR-IMMT has developed and tested a process for the treatment of Nalco fly ash through pyro-hydrometallurgical route to produce various value-added products such as alumina (metallurgical application and chemical grade), impure quartz (glass applications), calcium silicate (insulating boards, fire retardants and chemicals) and iron hydroxide (red oxide and pigment). The iron hydroxide generated during the processing of fly ash contains the Rare Earth Element (REE) values in a concentrated mass that can be processed further for the recovery of REEs. Further, sodium sulphate solution, the only effluent generated from the process, is treated through the splitting process developed by CSIR-IMMT for the production of sodium hydroxide and sulphuric acid, which can be integrated in the present scheme of fly ash process.

Keywords: Fly Ash, Rare Earth Element, Disposal, alumina, silica, iron values

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PL-04

Synthesis and Properties of Complex Metallic Materials with Hierarchical Microstructures

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Abstract- Ultrafine-grained or nanostructured metals and alloys are well-known as high-strength materials, with yield strength of about an order of magnitude higher than their coarse-grained counterparts. However, they often do not deform through the classical work hardening processes as in conventional metals and alloys, thus reaching room temperature failure at small strains soon after plastic deformation commences. Due to the lack or work hardening the deformation tends to become unstable and is prone to localization such as shear banding and necking in tension. This is a severe drawback causing concerns for catastrophic failure in many load bearing applications.

To circumvent such limitations, the concept of using heterogeneous ultrafine-grained or nanostructure-based materials and grain size distributions has been recently employed to control the mechanical properties of metallic high performance materials. Such non-uniform hybrid microstructures bear many similarities to the in situ composites developed to improve the deformation behavior of bulk metallic glasses. The recent developments along this line will be summarized and results for different types of metallic alloys will be presented to illustrate how the structural and functional properties can be tuned by appropriate phase and microstructure control. Experimental data for the resulting structures as well as types and density of defects will be described for selected materials, and the mechanisms responsible for their deformation behavior will be discussed. Consideration of the problems and challenges for the use of nanostructured and ultrafine-grained materials in engineering applications, as well as a discussion of the possible solutions, will also be addressed.

PL-05

Clean Energy and Energy Storage Pathway for Future Energy Storage Devices: Lithium Ion and Lithium Metal Batteries

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Abstract: The projected 28% increase of world energy consumption by 2040 coupled with the growing demand for zero-emission energy sources has brought increasing awareness for sustainable pathways to meet the incessant burgeoning energy needs of future generations. Generation of electricity from efficient, clean and renewable energy sources, such as solar (photovoltaic cell, PV), wind (wind mill), biomass, hydrogen, geothermal or hydropower, without producing carbon dioxide, an undesirable greenhouse pollutant, offers enormous potential for meeting future green and clean energy revolution. However, the electricity generated from these intermittent renewable energy sources requires efficient and sustainable stationary energy storage (ES) devices for efficient and reliable transmission and distribution (TD) of electrical energy (i.e., grid applications) to meet the demand during peak load, power stabilization, load leveling and distributed energy resources. In addition to stationary ES devices, there is a great need for high energy (≥350Wh/Kg), high power, compact, light-weight, cost effective (≤75$/kWh) and excellent life span (~2-15 years) ES devices for high energy and high power application such as advanced portable electronics (smart phones, laptops, smart cameras), medical devices, drone application, military purpose and transportation to transition from today's hybrid electric vehicular state enabling the realization of plug-in hybrids or the much desired all-electric vehicles (EVs).

Among various energy storage devices, the leading energy storage technologies till date are based on electrochemical energy storage (EES) devices. To meet the rapid development of energy storage devices for portable electronics, transportation and grid energy storage, extensive researches are currently devoted to develop efficient EES devices. Among the different EES technologies developed based on the fundamental electrochemical reaction, lithium batteries (LBs) have emerged as the flagship technologies offering the much desired panacea for high energy and high power applications such as in the advanced portable electronics, electric powered vehicle, military applications as well as stand-alone stationary power systems integrated into the electric grid. As Li-ion cells are approaching the limit of their capabilities, attempts to revive the safe and reliable LMBs are becoming a necessity for exceptional energy demand in the future and strongly regarded as the next-generation batteries beyond LIBs. The LMBs, including Li-sulfur (Li-S) batteries, Li-oxygen (Li-O_2) batteries, Li metal anode vs intercalation type cathode batteries, etc., indicate a huge increase in theoretical energy density relative to the current LIBs (Li-O_2, 3505 Wh/kg; Li-S, 2600 Wh/kg). A safe and efficient operation of lithium metal anodes will decide the fate for next-generation energy storage systems, including rechargeable Li-air batteries, Li-sulfur batteries, and future Li metal batteries. The current status and the future direction of energy storage devices for high energy and high-power applications will be presented and discussed.

An overview of cored wires for welding stainless and heat-resisting steels.

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Abstract: Corrosion resistant alloy cored wires are commonly chosen nowadays for cladding and for joining. They are used in applications involving corrosion resistance and those involving service at elevated or cryogenic temperatures.
Cored wires are available with or without slag, for welding in all positions, with or without gas or flux shielding. Stainless steel, nickel base and cobalt base cored wires are currently used in industry. They are available with or without slag.
Stainless steel cored welding wires are composite products comprising a metal strip (folded into tubular form) and a powder filling. For a given analysis, several strip compositions are frequently available to choose from. The final analysis is adjusted through metallic additions to the filling. Allowance must be made for element burn-off and the effects of the shielding media.
The amount and nature of compositional adjustment by the filling can have an impact on the corrosion resistance under certain welding conditions. The shielding gas or flux used, if any, affects the composition of the weld deposit. The details of the design and formulation of the wire also exert a strong influence. Various production techniques for corrosion-resisting cored wires exist.
This presentation highlights some features of slag systems and core ingredients. Innovations have had a positive impact on the ability to exploit the productivity of stainless flux cored wires in areas where these consumables were previously forbidden or simply unsuitable. Practical applications are also described.
Examples of industrial applications are given to illustrate the potential of the cored wire solution.

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Recent developments in arc spraying consumables for the protection of heat exchangers in waste-to-energy plants

Mario Cordero, Aaron Cooper, Jean-Marie Bonnel
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Abstract: Waste to energy plants are rapidly becoming a preferred strategy to deal with the ever-increasing problem of waste generation globally. Although it is recognised as not the ideal solution, producing energy from waste alleviates the pressure on the lack of space required for new landfills. Furthermore, modern plants are highly efficient and meet strict regulations on emissions to the atmosphere.

One of the most difficult challenges by the industry is the wear faced in the heat exchangers, which drastically restricts efficient operation. This wear comes in many forms, being erosion and corrosion two of the most important ones. These two forms of wear are dependent on a very large number of parameters, such as the type of waste being processed, temperature requirements, etc. A second challenge is the accumulation of residues on the surface of the exchangers which also drastically reduces thermal efficiency.

This is a complex situation which requires full understanding and tailored solutions for different scenarios. In this presentation the approach taken by Welding Alloys Group to offer effective solutions will be presented.

Modern Manufacturing Technology- with special focus on Aluminium

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Abstract: Manufacturing has undergone many revolution and the process is never ending. The mass production model of early 20th century has been replaced by flexible multiproduct production units. For development of industries the only constant 'change' is possible only with technology development that forces gradual replacement of obsolete products with more acceptable product. For manufacturing of such products innovative technologies help in development of products. Growth of core manufacturing industries both in metal and non-metal segments need special focus. Having worked in an aluminium industry, I would like to focus on manufacturing opportunities, which I think will help the young budding engineers and entrepreneurs to pay special attention in development of aluminium products in India particularly eastern part, which is the aluminium hub of the country.

Metal Additive Manufacturing - Current challenges and Opportunities

Dr. R.V.S. Prasad
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Abstract: With a continuous demand for more complexity in design and efficient use of powder materials, Metal 3D printing commonly known as additive manufacturing (AM), has expanded exponentially in terms of application as well as development. The advantages of AM over conventional or subtractive manufacturing are obvious as additive manufacturing facilitates the creation of near-net-shaped components with minimal raw materials and enables the production of complex designs.
In the last couple of decades, there is significant developments in the AM field have expanded in terms of new and wide range of alloys, many incapables of production by other routes, often revealing enhanced mechanical properties. The intent of current talk is to provide broad overview of different AM processes ranging liquid to solid based as well as powder based. Further this talk gives more insights into DED (Direct Energy Deposition) as well as the key challenges and opportunities with respect to materials for AM in a broader sense.

Practical Challenges of Corrosion Performance in Manually Welded Super-Duplex Stainless (UNS32760) Tubes & Pipes in Oil & Gas, Offshore Industries

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Abstract: Super Duplex stainless steels are commonly used in offshore platform pipeline application in severe corrosive environment. But the practical challenges are pitting corrosion on pipe butt joints of weld metal especially at root areas. Experiments has been carried out with two different sets of welded samples of super duplex grade (UNS32760) pipes by using base metal matching super duplex filler metal as well as overmatching Hyper Duplex stainless steel (HDSS) at root pass followed by base metal matching filler wires by manual GTAW process.
Mechanical, corrosion (ASTM G-48 Method A) and microstructural analysis were carried out with all samples.
It was found that all the mechanical properties passed based on acceptance criteria, but corrosion test didn't pass all samples. The significant improvement on pitting corrosion properties observed on all the samples which were used HDSS at root pass followed by standard super duplex matching consumables. Further analysis also carried out on microstructural analysis to identify the presence of secondary phases and its influence on mechanical and corrosion properties.

Nanostructured ultrasoft magnetic materials for power transformers

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Naval Science & Technological Laboratory, Visakhapatnam, India
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Abstract: Power losses in electricity distribution and transmission constitute up to 20 % and are much higher compared to the values in other economically leading countries [1]. One of the main technical reasons is the core / hysteresis losses in distribution transformers. The core loss in the transformer is directly proportional to the magnetic coercivity of the core material. Use of advanced soft magnetic materials with low coercivity values significantly helps in reducing the core losses. Replacement of the conventionally used cold rolled grain oriented Fe-Si steels with amorphous Fe-Si-B alloy, having an order of magnitude lower coercivity helps in significant reduction in power losses [2]. The nanocrystalline Fe-Si-B-Nb-Cu soft magnetic material has further lower coercivity by an order of magnitude over amorphous Fe-Si-B and is presently being used in high frequency transformers for electronic applications [3].

Fabrication of the Fe-Si-B amorphous materials for transformer applications is carried out by Planar flow melt spinning process. This is a rapid solidification route in which the alloy is initially melt in a quartz / ceramic crucible followed by ejecting the liquid on a rotating copper wheel. The liquid rapidly solidifies and forms a thin foil of less than 50 µm thickness with cooling rates of the order of 10^5 ºC per second. Continuous lengths of the metallic foils are obtained by this technique. The metallic foils are later wound to form transformer cores. In case of nanocrystalline Fe-Si-B-Nb-Cu ultrasoft magnetic material, the amorphous ribbons are partially crystallized to form nanocrystals of Fe-Si in amorphous matrix. The microstructure helps in nullifying the magnetostriction, an important property which causes noise in the transformers. In this talk, the brief research findings in the fabrication of the Fe-Si-B-Nb-Cu nanocrystalline material are discussed.

Higher wheel speed is found to increase the free volume of the amorphous phase in Fe-Si-B-Nb-Cu ribbons and thereby increase the amount of nanocrystalline fraction upon crystallization and improve the soft magnetic properties [4]. A window of processing parameters for obtaining continuous ribbons with good surface quality is determined. The quality of the ribbons is found to be dependent on the stability of the melt puddle and thickness of the ribbons [5]. The composition of Fe-Si-B-Nb-Cu is optimized to yield superior soft magnetic properties [6, 7].

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INV-05

Applications of Hardfacing & Cladding in Process Industries

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Abstract: Properties of materials has always been amused mankind. During ancient times, when man needs weapons for hunting, he understood that they require a hard and sharp object and looked around in nature and found stones. Soon after they realized, objects can break easily. The quest for materials with a combination of properties is always a need. Most of the industrial components are required to be strong and tough. Although in certain circumstances, the strength and hardness are not sufficient and they fail not by facture but due to wear. In other circumstances, corrosion and oxidation properties could be required together with strength and toughness.

In the present paper, we are introducing various types of hardfacing, corrosion resistance alloys and the method of applying them on various industrial components. We will discuss about the material selection and application of hardfacing alloys for a Vertical Roller Mill and a Roller Press in a cement manufacturing plant. We also look at another case study involving cladding application for a Steel Plant. A brief account on impact of COVID-19 on hardfacing and cladding business will be presented.

INV-06

Invasion of Orbital Welding

Dr.Surekha Krishnan,
Ichor Systems Fremont, CA, USA

Abstract: Orbital Welding is an automatic welding process which is widely used in semiconductor, food, aerospace and pharmaceutical industries. The process is clean, repeatable and the welds obtained are consistent in quality. The operators can be trained easily and with just the touch of a button, a beautiful, quality weld is obtained. The history, types of machine heads, the electrodes used, the metals that can be welded, the advantages and disadvantages of orbital welding will be discussed. A special emphasis on the semiconductor product lines and a brief introduction to clean room will be covered. SEMI standards to which the welded components will be inspected will also be touched upon. The process will be compared to the conventional TIG welding process.

INV-07

Giant enhancement of thermal conductivity of aluminium-graphene composite through electron phonon engineering

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Abstract: We will present our recent study of electron phonon engineering in aluminium based devices. For example, a novel approach was applied for the development of Aluminium (Al) based composite materials for the fabrication of devices to be used as solar thermal collectors for domestic and industrial use. We report here the enhancement of thermal conductivity of 410 W/mK for the Al-graphene composite sintered devices (incorporation of 5% by weight of graphene into the Al system), which is higher than the bulk Al at room temperature. Also, we have observed that, the Co-efficient of thermal expansion (CTE) of Al-Graphene composite devices have less values compared to pristine sintered Al at different temperatures which indicates the Al-Graphene composites have higher strength compared to Al. The fabricated devices and synthesize composite materials have been evaluated in terms of different micro-structural characterization tools like field emission scanning electron microscopy(FE-SEM), energy dispersive X-ray analysis (EDAX), electron probe micro analyser (EPMA) etc for qualitative and quantitative analysis, which shows well distribution of the constituents of Al-Graphene composite materials over the scan areas. The sintered samples have also been evaluated through density measurement and they are found to be ≈ 97.5 % density after sintering. The morpho-structural investigation of the device by X-ray micro CT(computed tomography) reveals the quality of product and the absence of the pores. It shows high dense sample with no voids and cracks, implying uniformity. Interestingly, the electrical conductivity of the composite remained similar or better than that of pristine aluminium- while giant enhancement observed in the thermal conductivity of the composite. The thermal fusing of Al based composite materials can be well deployed as solar thermal collectors for solar water heating. Theoretical and computational studies provide the atomic level understanding of interplay between electron and phonon dynamics in aluminium from atom to bulk.

INV-8

Manufacturing Processes of Advance Oxide Ceramics

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Abstract: ANTS Ceramics Private Limited started manufacturing of Advance oxide ceramic components with Gel Casting technology. Gel Casting technology was commercialised from Materials Science Center, IIT Kharagpur. The need of development of other technologies, leads to commercialise different powder metallurgy routes like slip casting, powder compaction, vibro-casting etc. In this forum, we will discuss different manufacturing process details like slurry preparation, casting, spray drying, powder compaction, die design, sintering and ceramic grinding lapping processes. We will also focus on parameter optimisation processes and property -process correlation related to application.

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High chromium cast iron filler metals: an Industry 4.0 approach

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Abstract: High chromium cast irons are widely used as wear resistant materials. They consist of carbide precipitates in a eutectic matrix of carbide and austenite. Performance depends on the type, hardness, morphology, distribution, volume fraction and orientation of the crystallysed carbides within their microstructures, as well as on the nature of the matrix supporting these carbides
Welding Alloys has taken on board an Industry 4.0 approach using the latest computational modelling to optimise and harmonise the high chromium cast iron range of consumables. Information from the literature and from historical experimental data taken from Welding Alloys Group were combined into a large database.
By combining fundamental thermodynamic principles, expertise on high performing microstructures and neural networks, a model was developed. The new model is capable to predict optimised potential formulations for the new generation of hardfacing welding consumables. Model validation data will be presented and discussed.

Effects of Niobium and Boron addition on the properties of Iron based materials for Hardfacing applications

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Abstract: Iron based hardfacing alloys are one of the most sought-after alloys in the hardfacing industry due to its versatility, suitability and evident cost factor. Typically, an iron base hardfacing alloy would have carbon and chromium as the crucial auxiliary elements and depending to the attributes and properties to be achieved, further alloying with titanium, tungsten, molybdenum, vanadium, niobium, etc. are common. Numerous works have shown niobium and boron to be of good potentials as hardfacing elements. However, both being the main constituents in one system is rare where addition of more elements is common. Boron apart from being relatively cheap also able to provide excellent toughness and hardenability properties wherever it is incorporated. However, due to factors of embrittlement and decrease in toughness whenever used in higher weight percentages, it has by far been utilized only in very small weight percentages in most works. This work is aimed at evaluating the effect of niobium and boron addition on the wear and mechanical properties of iron-based alloy. Alloys with addition of 2 to 8wt.% niobium and 0 to 2wt.% boron to iron was developed and prepared in 1.6mm flux cored welding wires respectively. All weld metal (AWM) samples of 7 layers were welded with Ar+CO_2 as shielding, sectioned, analyzed under optical, SEM, EDAX, XRD and tested with Rockwell, Vickers hardness and ASTM G65 wear tests. Presence of various hard phases and matrix strengthening mechanisms resulted in the increment of hardness in each alloying category. As niobium was increased to 8wt.% the hardness increment was observed to escalate up to 12.65% which was at only 3% approximate in 2wt.% to 6wt.% niobium added alloys. In the 1wt.% and 2wt.% boron added alloys, hardness increment of 1.8% and 1.9% was attained respectively with increasing of niobium wt.%. Wear resistance behaviors was observed to improve in proportional to these increments as well where the 2wt.% boron+8wt.% niobium added alloy showed greatest anti-wear behavior amongst all.

INV-11

Resource recovery from Electronic Waste in Today's environment: Challenges and Opportunities

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Abstract: The developments in the field of information and communication technology, population boom and changes in the life style are results in the catastrophic rise in the utilization of electrical and electronic equipments (EEE) products by the mankind. Moreover, the competition between the different manufactures of EEE, availability of the global market and consumer behaviour to the gadgets, forces the manufacturers to reduce the cost of gadgets. Along with the increase in the number of electronic products, waste components developed from EEE products are also proliferated proportionally. E-waste typically contains complex combinations of materials and other components down to microscopic levels. The wastes are broken down not just for recycling but for recovery of precious materials. E-waste can be utilized as source of recyclable and recoverable materials with enormous employment opportunities through developed technology. It is evident that the demand of virgin material for the manufacturing of the new electrical and electronics equipments is increasing every day. The materials mined from natural resources consume ten times energy with respect to recovery of materials from E-waste. In view of that the recovery of recyclable materials from E-waste releases environmental pressure on all natural resources until unless it is carried out by environment friendly techniques and methods.

Plastics are a significant constituent of electrical and electronic equipments, about 35% by weight, majorly used for insulation, noise reduction, sealing, housing, interior structural parts, electronic components etc. These components, after their utilization, are discarded and termed as a fraction of waste electrical and electronic equipment (WEEE or E- Waste). Acrylonitrile butadiene styrene (ABS), Polypropylene (PP), Polystyrene (PS) and Polyurethane (PU) are the major polymers representing more than 70% of WEEE followed by Epoxy (printed circuit boards) and PVC (wires/cables/connectors). Plastics being a magic material can easily recyclable for various high end application. Further, the materials mined from natural resources consume ten times energy with respect to recovery of materials from E-waste. In view of that the recovery of metals from E-waste releases environmental pressure on all natural

The aerospace sector demands high performance and reliable weld joints with consistency. The traditional concept of riveting the aero structures is gradually being replaced by certain fusion and solid state welding processes. The primary reason for such a changeover is, flexible designs, cost savings and structural integrity which are possible with high quality weld joints. Electron beam welding (EBW) process is one of the most reliable and advanced welding process which can consistently produce stringent quality weld joints with high depth to width ratio even with relatively faster welding speeds. The present article explores the process details of electron beam welding, various sub systems of EBW equipment, characteristics of electron beam, weld joint design, effect of welding parameters on the weld joint geometry and its performance. The application of the EBW process in manufacturing of aerospace structures and other sub-assemblies are also discussed

INV-12

Electron beam welding: Process, techniques and its use in aerospace sector

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Abstract: The aerospace sector demands high performance and reliable weld joints with consistency. The traditional concept of riveting the aero structures is gradually being replaced by certain fusion and solid state welding processes. The primary reason for such a changeover is, flexible designs, cost savings and structural integrity which are possible with high quality weld joints. Electron beam welding (EBW) process is one of the most reliable and advanced welding process which can consistently produce stringent quality weld joints with high depth to width ratio even with relatively faster welding speeds. The present article explores the process details of electron beam welding, various sub systems of EBW equipment, characteristics of electron beam, weld joint design, effect of welding parameters on the weld joint geometry and its performance. The application of the EBW process in manufacturing of aerospace structures and other sub-assemblies are also discussed

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INV-13

E-Waste recycling: key challenges and emerging technologies

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Abstract: Waste Electrical and Electronic Equipment (WEEE) is one of the fastest growing solid waste. E-Waste is considered as one of the rich source of some of base metals and precious metals. Urban mining, recovery of metals from secondary sources including E-Waste, is gaining importance in recent times. CMET Hyderabad has developed recycling technology to recover precious metals like Au, Ag and base metals like Cu and lead from printed circuit boards in environmental sound way. E-Waste recycling faces various challenges in collection, preprocessing and end processing. Material challenges posed by various legislations and thereby the difficulties faced by recyclers are discussed. Emerging e-waste technologies are also discussed.

Experimental and Simulation Studies of DEASA (Dayalbagh Educational Air Shower Array) based on 'Hands-on-Learning Teaching-Research 'Model using CORSIKA, GEANT4 and ROOT tools for undergraduate students

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Abstract: The Dayalbagh Educational Institute has funded the setting up of DEASA (Dayalbagh Educational Air Shower Array) an air shower array of eight detectors of 1m x 1m x 2 cm in collaboration with Cosmic Ray Laboratory (CRL), Ooty, Tata Institute of Fundamental Research, Mumbai. The mini detector array has been designed, assembled and electronics connected with each detector by the students in Nuclear physics laboratory. The studies are based on Linsley effect which "measures the spread of the arrival times in particle samples and makes it possible to estimate the distance to the shower axis" (A.A. Radu et al, Romanian Reports in Physics, Vol. 60, No. 1, P. 45–55, 2008). After the 1940's theoretical and experimental studies had established that an air shower has nuclear and electromagnetic components. At present with 70 years of accelerator-based research, the cosmic rays still give us the lead to understand the high energy interactions. Even after 107 years from their discovery, cosmic rays are being studied through experiments all over the globe. An interesting fundamental observation of the "neutron thunder" is now added to our knowledge of these energetic particles which needs to be further studied (A.D. Erlykin, Astroparticle Physics 27,2007).

The international ground-based arrays are KASCADE, AGASA, PIERRE and national experiments coming are INDIGO, INO, India's SPACE STATION and GRAPES3. The aim of our set-up experiment is to make the students skilled in the basic techniques required for these experiments. Instead of theoretical learning and discussion of their results, the author has designed hands-on-learning sessions with the undergraduates and post-graduates of Faculty of Science. The author has students involved in basic studies of the muon telescope which was built by the students at CRL, Ooty, setting up the NIM based electronics, data taking, analysis, Geant4 based Monte Carlo simulations. The next task is to do the air shower studies in the same manner with a mini detector array. "According to Boyer Commission model the scholar-teachers treat their research sites as seminar spaces open to undergraduate and post-graduate students, where regardless of academic level, all can practice their research skills and help develop others' proficiency" (S. Guatelli et al., Transferring Advanced Physics Research Tools to education, Proceedings of INTED2010 Conference, Spain).

The experiment shall be the "Showers of Knowledge bringing the users globally together to the analysis of metadata accumulated in real time of the studies done. This will study the basic fundamentals in science (L. Baldini," Space based Cosmic Ray and Gamma Ray Detectors: a review" arxiv:1407.7631v2) more accessible and encouraging for the internet users and students". The endeavor will reduce the bridge between the research in modern science and the skilled levels of the society. The targets shall be the high school, undergraduate, post-graduate students and the keen global users. The cosmic rays are a relevant platform for a basic understanding into the techniques of modern science like experimental set-up, data taking, analysis and simulation.

Sustainable development

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Abstract: Innovation plays very important role in the technological , Industrial and thus economic development of nation. This Innovation takes place in R & D centres, laboratories, research institutions and colleges across country. The high quality equipments used in the laboratory are mostly imported and budgeted beyond the capacity of common researcher. Indigenous equipments are based on the decade old designs and technology, which results in frequent breakdowns and causes delay in research. The current market is based on profiteering from repairs and service rather than providing a durable product. There is dire need of high quality indigenous equipments at reasonable pricing. There are some established Indian players in the market. Indian manufacturers need to work on design, process calculation implementation and simulation to make better product than foreign counterparts and should have the ability to customise as per customer need. Metwiz Materials Private Limited, with its expertise, working on filling the market gap and reduce the dependence of the imported process equipments with use of our expertise and innovations.

Promoting the use of cement-less building materials with industrial wastes: efforts of Green Tech Concrete and Research (GTCR) for a sustainable future

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Abstract- The conventional cement production process not only causes huge carbon emissions, but also consumes massive amount of natural resources and energy. It is estimated that, for 1 ton of Portland cement, approximately 4 GJ of energy is consumed, and 1 ton of CO_2 is emitted to the atmosphere [1]. Considering the increasing demand for building and road infrastructures, a huge demand is anticipated on the cement production in near future. On the other hand, the global warming and climate change are occurring in unprecedentedly and it is obvious that the cement industries are also plays a great part, since they alone contribute 7-8% of the total CO_2 emission [2]. Henceforth, several efforts have been made to develop cement less concretes and building materials to minimize the environmental concerns imposed by cement industries [3][4][5]. Joseph Davidovits was the first to invent a class of inorganic polymers (geopolymers) that have cementing property as like conventional cement and can be made from industrial wastes instead of natural ones. This geopolymers can be prepared by activating industrial wastes such as fly ash (FA), blast furnace slag (BFS), rice husk ash (RHA) etc. with alkaline liquids, and have similar or even better performance in some cases (sulphate and acid resistance) than the conventional cement based building materials (concrete, plaster, blocks, road materials etc.).
With time, geopolymer emerged as one of the sustainable replacement of conventional cement based materials, since it helps to utilize the industrial wastes in bulk and also solves the problems associated with cement production. Counties like Australia has commercialized this, and using this material for its infrastructure developments. Though the geopolymers are more cost effective in long run, but they need high initial cost as compared to the cement based materials. This cost is generally imposed by the high cost of alkaline activators, as the waste materials (FA, BFS etc.) are freely available. Hence, counties like ours (India) is unable to use this material due to high initial cost as compared to conventional cement based materials. Therefore, a new method to prepare an alternative alkaline activator was developed to produce low cost cement-less building materials [6]. In this method, rice husk ash (RHA) which is a waste generated from rice mills was used to produce a special chemical activator to produce geopolymers, which have similar performance as like conventional one. The compressive strength of this new material ranges in between 45-55 MPa by 28 days of atmospheric curing (no water is required for curing like cement based materials). This innovative method can be used to produce cement-less building materials like concrete for structural applications in both buildings and roads, concrete blocks for masonry, paver blocks for pavement applications, tiles for flooring, and many more at a very reasonable cost. An Indian patent application is also filed on 14th October 2019 to protect this invention having application no- 201931041466. To implement and commercialize this new green technology, an organization is formed named as Green Tech Concrete and Research (GTCR) which is in the process to be established soon.
Since, the need for paving materials (paver blocks) for footpaths in cities and tile for flooring are increasing with rapid urbanization, GTCR will manufacture these building materials in the first phase soon in the early of 2021. The cost of these cement-less building materials is expected to be less than

the cement based materials with other additional advantages like low environmental impacts, waste utilizations and low water consumption.

YEA-04

Zero rpm-Synthesized Tunable Plasmonic Hollow Silver Nanoshells in the First and Second Near-IR Windows for Enhanced Solar-Catalysis

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Abstract- Hollow silver nanoshells (HAgNS) having surface plasmon resonances (SPR) in the second near-IR window (1000-1400 nm) have been synthesized for the first time. A new method based on nanoscale Kirkendall effect has been developed in which dimethylglyoxime (DMG) acts as capping agent as well as growth moderator. Folic Acid (FA) is further added at room temperature to impart aqueous solubility and stabilization. It finally yields water-soluble, DMG-FA-capped HAgNS. The synthesis process was analyzed for wide range of stirring speeds from zero rpm to 1350 rpm. The synthesis at zero rpm was found to be the best as it yielded HAgNS having narrower SPR band (reduced FWHM) along with greater red-shift of the SPR peak upto 1150 nm in the NIR region. The invention establishes zero-rpm synthesis (no stirring, magnetic or otherwise) as a greener and cost-effective route to obtain 'high quality' HAgNS thereby bringing the energy expenditure to zero. HAgNS exhibits two prominent SPR peaks in the absorption spectra, one corresponding to the quadrupole mode (Q-SPR) and the other symmetric dipole mode (SD-SPR). By deftly controlling the aspect ratio (outer diameter/shell thickness), the dipolar resonances (SD-SPR) have been tuned in a wide NIR range spanning 780 nm to 1150 nm. For the hollow silver nanoshells, this is the maximum red-shift achieved till date in SPR peaks. The spectral range corresponding to 650-1400 nm represents the biologically transparent window which is further divided into two sub-windows: NIR-I ranging from 650-950 and NIR-II ranging from 1000-1400 nm. The latter, i.e, NIR-II window, is more suitable for theranostic applications as scattering becomes very low which means light can penetrate deeper and photothermal efficiency is enhanced. As the SD-SPR is tuned in the NIR II window, the Q-SPR of the HAgNS is concomitantly tuned from 450 to 560 nm in the visible region. Additionally, a less prominent peak is also observed at 330 nm in all these samples which are attributed to antisymmetric dipolar resonances (AD-SPR).
Transmission electron microscopy (TEM) revealed that all HAgNS are single-crystal hollow spheres. HAgNSs with tunable plasmon peaks (λSD-SPR) at 780, 850, 920, 1010, and 1150 nm were synthesized (hence named as HAgNS-780, HAgNS-850, HAgNS-920, HAgNS-1010, and HAgNS-1150, respectively). The corresponding outer diameters were 53±3, 50±3, 54±3, 62±4, and 40±1 nm as determined by HR-TEM and the aspect ratios (Outer diameter/Shell thickness) were 3.31, 3.33, 3.48, 4.13, and 5.33, respectively.

Besides, the HAgNSs were found to be good catalysts in sunlight, for the degradation of dyes, namely, Methyl Orange (MO) and Bromocresol Green (BCG). In sunlight as compared to solid silver nanospheres (SAgNS-400; λSPR=400 nm) HAgNS-920 and HAgNS-780 exhibited 3.6 and 3.19 times higher catalytic efficiency respectively. Additionally, HAgNS-920 vis-à-vis HAgNS-780 acted as a better catalyst for BCG within NIR window. Thus, the NIR window of the solar spectrum displayed greater efficiency with HAgNSs as plasmonic photocatalysts. The invention will open new vistas in faster and effective remediation of dye-effluents emanating from the textile industry.

Flower Carbon nanotubes: Blackest than Black

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Abstract- A partially or fully invisible surface to an observer can create confusion in their mind. Such surface is highly useful for defence applications. These kinds of confusing surfaces can be a key to win a war in the modern world. Such kind of camouflage can be created by ultra-black optical absorbers which also finds huge applications in energy harvesting devices, telescopes, and infrared cameras. From the past few years, researchers are working to design a near perfect optical absorber which can trap light independent of incident angle and wavelength. To fabricate such a near perfect absorber vertically aligned carbon nanotubes can be one of the best candidate due to its structure and morphology. However, the biggest challenge remains CNTs alignment. Keeping this in mind authors tried to address this problem through novel CNTs morphology named as flower carbon nanotubes (FCNTs). The developed FCNTs has hierarchical nanostructure due to dual growth step. Light trapping capacity is found to be more than 99.9 % with an emissivity of 0.98 in UV-Vis-NIR wavelength range. Due to its ultra-high absorption it is found that the fabricated FCNTs are blackest manmade surface. Moreover, the fabricated FCNTs are superhydrophobic in nature with a contact angle of 170° and roll-off angle of 2°.

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The Synthesis of PEMA/PVA/BN@Ag Nano hybrid thin films

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Abstract- The PEMA/PVA/BN composite and PEMA/PVA/BN@Ag nanocomposite is prepared in situ polymerization method. The composite and nanocomposite are systematically characterized by FTIR, TGA and DLS. The tensile strength, chemical resistance, biodegradable and antibacterial properties of the composite and nanocomposite has been investigated. The interaction of nano particles and polymer marrix is studied by FTIR. The formation of composite and nanocomposite is confirmed by DLS. From TGA analysis, it shows that the thermal stability of nanocomposite increases as compared to composite. The antibacterial properties of nanocomposite improves in comparision with composite. This is due to the incorporation of Ag nano particles in polymer matrix.

Metal Oxide Nanomaterials for Humidity Sensing Application

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Abstract- Various industrial applications such as food processing, air conditioning, paper & textile, chemical, civil, etc. encounter the problem of unwanted humidity and uncontrolled levels, playing on their quality of product and services. Therefore, monitoring and control of humidity is of prime importance. Sensitivity and cost of humidity sensors are two important parameters of sensors to be used in various applications. The challenge exists to develop humidity sensors with improved sensitivity, low hysteresis and low response/recovery time [1-2]. In the last few decades, metal oxides have been actively studied due to their unique properties like high surface to volume ratio and unusual adsorptive properties. Change in resistance of porous metal oxides for different environments is related to the water adsorption mechanism on the oxide surface. Doped metal oxides exhibit different types of morphologies, various properties and have many applications. Doping has significant impact on the electrical, physical, chemical, optical and other properties of the metal oxides. Doping improvises the microstructure and the related properties and thus the sensitivity, reproducibility, response and recovery times are all improved.

Various metal oxides in pure form and with impurity doping have been investigated for humidity sensing studies, based on variation in dc electrical resistance of the sensing elements with humidity. Metal oxide nanomaterials were fabricated through solid state reaction route and sol gel technique. These nanomaterials were pressed into pellet shape under pressure of 200-800 M Pa at room temperature. The pellet samples were annealed in air at 200 - 800°C for 3-6 hours. On exposure to humidity, the dc electrical resistance of the pellets decreased as the relative humidity increased from 10-95%. Moisture sensing studies have been explored for Cu doped WO_3, Ag doped WO_3, ZnO doped NiO, Cu-doped ZnO, SnO_2-doped ZnO, Al_2O_3-doped ZnO, and many other nanocomposites. The sensitivity recorded ranged in very high values from 2000 KΩ/%RH to 30000 KΩ/%RH for various sensing elements. Doped sensing elements manifested low hysteresis and better response and recovery time compared to the sensing element of undoped metal oxides. [3-4].

Keywords: Doping, Adsorption, Metal Oxides, Humidity Sensor, Electrical properties, Resistance, Annealing, Response, Recovery, Hysteresis, Sensitivity.

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Human Motion Interactive Mechanical Energy Harvester Based on All Inorganic Perovskite-PVDF

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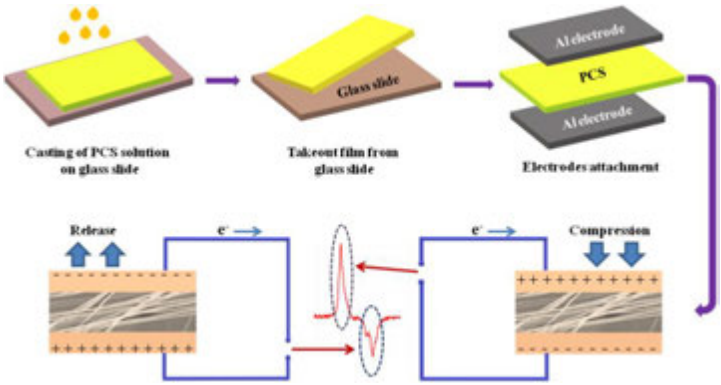
Abstract- Benefited with the advantage of easy assembly and conformal structure, flexible and self-powered piezoelectric nanogenerators (PNGs) have become a sustainable and accessible energy alternative. Here, a novel piezoelectric sensor is fabricated by a composite of room temperature processed all-inorganic cesium lead bromide ($CsPbBr_3$) perovskite rod and polyvinylidene fluoride (PVDF) nanofiber. $CsPbBr_3$ enables nucleation of the electroactive β phase in PVDF >90% and makes it suitable for piezoelectric energy harvesting. Piezoelectric energy generation from the devices has been investigated under several simple human movements like hammering by hand, finger touch, toe pressing, bending by arm, etc. Optimized $CsPbBr_3$-PVDF composite (with 5 wt% of $CsPbBr_3$ loading) based PNG delivered an output power 4.24 mW with a high open-circuit voltage of 120 V and short-circuit current of 35 μA. Such high output value for the composite sample suggests much-improved energy conversion efficiency as compared to the building blocks separately. The fatigue test of the PNG under the continuous mechanical impact (over 4 months) showed its possibilities as a robust wearable mechanical energy harvester. This device is also able to light up several commercial LEDs. An increase in output values is attributed to the improved polarization in PVDF by CsPbBr3 incorporation. Additionally, the photosensitivity of the composite is demonstrated under light, which indicates its potential as a photodetector. Considering the photo-response and electroactive features, a new class of self-powered photoactive piezoelectric energy harvester has also been fabricated. Such results highlight the rational design of all inorganic perovskite-based nanoforms in maximizing device performance and thereby providing a useful pathway to develop new materials for piezo-phototronics.



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Effect of Gd Doping on Structural and Optical Properties of ZnO Nanorods

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Abstract- Pure ZnO and Gd doped ZnO nanorods were synthesized by a cost-effective chemical method. Structural analysis of the samples revealed that all the samples exhibit hexagonal wurtzite structure. The average diameter of the nanorod was increased from ~ 56 nm to 67 nm with increasing Gd doping concentration from 0 to 5%. UV-Visible absorption spectral characterization indicated Gd doping effectively reduced the band gap of ZnO i.e. band gap of ZnO decreased from ~ 3.25 to 3.17 eV with increasing Gd doping from 0 to 5%. The room temperature photoluminescence spectra of the samples confirmed the presence zinc and oxygen vacancies in the samples and the samples exhibited strong UV emission along with different defect related emission. Our study indicated the ZnO nanorods could be useful for UV light emission device application.

Flower Shaped Au NPs for Plasmonic effects in inverted OSCs to enhance efficiency

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Abstract- Efficient absorption of light in invertedorganic solar cells (OSCs) is essential for their excellent performance and the incorporation of Au nanoparticles of suitable shape, size and concentration in electron transport layer (ETL) layerserves the purpose without compromising their architecture. Theincorporated Au NPs (5-50nm) behave as antennas for the incoming light and energy is stored in localized surface plasmon modes which leads to multiple timesenhancement of the electric field resultingin enhancement of the light absorption. The increase inexciton dissociation is possible with the help of interactions between the plasmons and the excitonsthereby reducing the level of exciton loss through recombination. By optimizing the geometry, size, concentration and position of the Au NPs, the performance of plasmonic inverted OSCs can be improved to a significant extent.The addition of the Au NPsimprove the performance of the OSCs usingthe optical propertyof localized surface Plasmon resonance (LSPR) withoutaffecting their electrical properties.Metallic nanoparticles for plasmonic devices are generally made of aluminium, silver, gold or copper due to theirstrong interaction with the sunlight. Gold is widely used due to its high resistance to oxidation and henceensuresa longer life to the device.We have synthesized flower-shaped Au nanoparticles by mixing 10mM gold salt (200 µl) with 20 mM ice-cold ascorbic acid (70ml). The reaction mixturewas continuously stirred and the reaction vessel'stemperature was maintained at 5^0 C throughout. The average size of Au nanoflowersanalyzed by TEM was found to be of the order of 30 nm. Also, the absorption spectra matched well with the standard spectra confirming the formation of Au nanoflowers.

Hydrothermal growth of SnS nanosheets for self-powered photodetection

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Abstract- Self-powered photodetectors based on layered semiconductors have captivated huge attention owing to low-powered consumption and fast photoswitching. Herein, we report facile synthesis of graphene like SnS nanosheets by hydrothermal growth. Grown SnS nanosheets have orthorhombic crystal structure with (040) preferred orientation. Subsequently, ITO/SnS/ITO photodetector is fabricated and exploited for photoswitching in broad spectral range from 390-780 nm. Photodetector has exhibited excellent self-powered photoresponse with great reproducibility over hundreds of illumination cycles. Encouragingly, photodetector has shown fast detection ability with response time as small as 82 ms. Photoresponsivity of 1.63 mA/W, specific detectivity of $\approx 10^9$ Jones are achieved for self-powered photodetection which is significantly enhanced as compared to previous reports. Finally, present research advocates the enormous progress in the field of self-powered opto-electronics.

Effect of urea on mechanoluminescence properties of $SrAl_2O_4$:Eu,Dy nanophosphor synthesized by combustion method

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Abstract- A green $SrAl_2O_4$:Eu,Dy nanophosphor has been synthesized by combustion method at 600°C temperature. The dependence of the mechanoluminescence (ML) properties of $SrAl_2O_4$:Eu,Dy nanophosphor upon urea:nitrate concentration is investigated. The monoclinic phase in prepared phosphor is confirmed by X-ray diffraction. The photoluminescence (PL) properties of $SrAl_2O_4$:Eu,Dy nanophosphor show that the phosphor gives green colour of emission at 515 nm, which is corresponding to $4f^6 5d^1 \rightarrow 4f^7$ transition. Further, it is found that the ML intensity increases with an increase in the ratio of urea and reaches a maximum at 2.5 followed by a decrease with further increase in the ratio of urea.

Room Temperature Chlorine Sensors Using Phthalocyanine Nanostructures

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Abstract- Phthalocyanine based organic semiconducting materials are promising candidates for room temperature chemiresistive sensors as their electrical conductivity changes on interaction with oxidizing/reducing gases at room temperature. Sometimes small response characteristics of these sensors at room temperature becomes a limitation, which can be overcome by exploring long range molecular nanostructures with high surface/volume ratio.

With this aim in view, our research group is engaged in the development of cost effective, highly sensitive and reproducible phthalocyanine based room temperature chemiresistive sensors capable of detecting toxic gases at parts-per-billion level. We have synthesized phthalocyanine based nanowires, nanoflowers, nanobelts and their nanocomposites with carbon nanotubes/graphene by using a simple and low cost self-assembly technique [1]. Recently we have reported for the first time phthalocyanine nanowires as highly selective and sensitive room temperature Cl_2 sensor with response as high as 715% and detection limit as low as 5 ppb [2]. In this talk, we will discuss the room temperature gas sensing characteristics of phthalocyanine nanostructures and nanocomposites [3] along with their formation, sensing mechanism and absorption kinetics.

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Functional facet isotype junction and semiconductor/r-GO minor Schottky barrier tailored In_2S_3@r-GO@(040/110)-$BiVO_4$ ternary hybrid

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Abstract- Efficient interfacial exciton transfer and separation have been regarded as the foremost confront of semiconductor oriented photocatalysis. The simultaneous discovery of crystal facet isotype heterojunction across the (040)-reduction and (110)-oxidation facet of monoclinic scheelite $BiVO_4$ crystal; and Schottky junction at the interfacial region of $BiVO_4$ crystal with well-exposed functional (040) facet and r-GO sheets has been reflected as an efficient electron injection route. In this context lucrative architecture of a high productive all-solid-state Z-scheme charge transfer dynamics In_2S_3@r-GO@(040/110)-$BiVO_4$ isotype ternary hybrid photocatalyst was carried out and well-validated by FESEM and HRTEM analyses. Photoelectrochemical measurements have revealed that the accumulated photo-electrons over the exposed (040)-crystal facet of $BiVO_4$ truncated bipyramid easily cross the minor Schottky junction to expedite the unidirectional injection to the π–π conjugated two-dimensional planar r-GO structure. Besides, subsequent trapping of the injected electrons by the photoinduced holes of In_2S_3 leading to a superior charge carrier separation in the material, validated by PL, EIS, Mott-Schottky, and transient photocurrent analysis. Perceptibly, this intimate interfacial interacted crystal facet dependent electron shuttle provided a longer life span electrons and holes to settle in the conduction band of In_2S_3 and valence band of (110)-$BiVO_4$, respectively, for elevated photo-activity efficiency. The In_2S_3@r-GO@(040/110)-$BiVO_4$ ternary hybrid contributes 89.7% of Ciprofloxacin (CIP) detoxification in 150 minutes and 885.43 μmol of O_2 evolution in 120 minutes. More in, the constructive interrelations of resultant Physico-chemical, photoelectrochemical, and augmented photocatalytic redox efficiency were well-illustrated. This unique association semiconductor ternary hybrid photocatalyst via metal-free mediating agent crystal-facet sandwich structure will provide a scientific innovative basis for rational design and realization of advanced Z-scheme photocatalytic system for energy and environment application.

Keywords: (040/110)-$BiVO_4$, facet isotype heterojunction, Schottky junction, r-GO mediator, Z-scheme, ciprofloxacin, water oxidation

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Magnetic Properties of (Mn, Al) doped SnO2 nanoparticles: Synthesis and Characterization

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Abstract- Pure and (Mn, Al) co-doped into SnO_2 nanoparticles are synthesized by using chemical co-precipitation method, with different concentrations of Mn (1, 3, 5 mol %) and constant concentration of Al at 5 mol% doped into SnO_2. The X-ray diffraction (XRD) studies reveal that the formation of single phase tetragonal rutile structure of pure and (Mn, Al) doped SnO_2 nanoparticles. The particle sizes are in the range of 20-30 nm calculated from XRD data. Raman studies reveal that the pure and (Mn, Al) doped SnO_2 nanoparticles obtain active modes at 150 (B_{1g}), 306 (E_u), 476 (E_g), 625 (A_{1g}) and 776 cm^{-1}(B_{2g}), corresponding to tetragonal rutile phase structure of SnO_2. Micro graphs of Scanning Electron Micro scope (SEM), show that the surface morphology of samples are non unifom spherical in shape and chemical composition of samples are analyzed by EDAX spectra. From this the presence of Sn^{4+}, Al^{3+}, O^{-2} and Mn^{2+} ions are confirmed in the prepared samples. Micrographs of Transmission Electron Microscope (TEM) confirm the non-uniform spherical shape surface morphology of nanoparticles and their sizes are about 20- 30 nm. UV-VIS absorption spectra show absorption edge at ~320 nm, whereas the photoluminescence spectra show that emission peaks are at 419 nm, 420 nm, 442 nm, 445 nm and 462 nm with excitation wavelength at 350 nm. These emission peaks are conformed to absorption spectra. Vibrating sample magnetometer (VSM) studies show diamagnetism for pure SnO_2 and for (Mn, Al) co-doped SnO_2 samples shows paramagnetism to ferromagnetism. The ferro magnetism (PM) is increased for (Mn, Al) co-doped SnO_2 samples by increased Mn concentration.

Keywords: Tetragonal rutile phase, co-precipitation, RTFM, excitation, absorption edge and VSM

Synthesis and Characterization of Nanostructure Polyethylene

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Abstract- Polymeric materials are extensively used in many fields of applications, ranging from aerospace to microelectronics, optoelectronics, composites and fiber optics due to low density, flexibility, versatile electronic properties, chemical inertness and low cost [1,2].Different surface modification techniques have been developed in order to transform these inexpensive materials into highly valuable products. Among these surface treatment techniques, the most common used are plasmas, corona discharge, ion beam and others techniques. Plasma treatment provides a unique way to modify the chemical, structural, optical, geometrical and electrical properties of polymers by causing the irreversible modifications in structure and chemical composition [3,4].

In this work we have modified the polyethylene (PE) surface by argon plasma treatment using Radio frequency plasma system. Polyethylene (PE) is a widely used polymer in medical, electrical, optical, electronic, thermal and many other applications due to low cost,desirable mechanical properties, good chemical resistance, biodegradability, easiness of processing and theabsence of toxic byproducts. All the PE samples were treated using a Ar plasma with different time ranged from 10-30 min. A DC bias voltage (− 200 V) was applied to the substrate holder. Scanning electron microscopy showed that PE formed the ripple like nanostructureat the surface induced by Ar plasma treatment for lower plasma treatment time while for higher time PE formed fiber like nanostructures (nanofiber). The different bonding information analysed by Fourier Transform Infrared spectra (FTIR) spectra. Optical transparency and optical band gap of the PE decreased with the increase of Ar plasma treatment time measured from UV/VIS spectrum.

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Sensing characteristics of CNTs/Pcs based materials for chemiresistive gas sensing application

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Abstract- Carbon nanotubes (CNTs) possessing unique structure and properties have found remarkable interest in sensing application owing to their unique one-dimensional nanostructure and high surface area-to-volume ratio[1]. However, it is worth mentioning that insolubility or poor dispersibility of pristine CNTs in most of the solvents poses a serious obstruction to their further applicability in gas sensors. To improve the solubility and gas sensing characteristics of CNTs based sensors, functionalization of nanotube surface by introduction of various functional groups and composite of CNTs with noble metal nanoparticles[2], metal oxides[3] and organic semiconductors[4] have been explored. Among organic semiconductors, Phthalocyanine (Pc), have been emerged as an excellent sensing material due its high sensitivities, excellent thermal and chemical stability. Further, substituting functional groups on phthalocyanine molecules make them soluble in various organic solvents and thus enable them for low cost solution processing techniques such as spin coating and self-assembly etc. In this context, we expect that combining the nanoscale CNTs with gas sensing active Pc would feature not only the intrinsic properties of CNTs and Pc arising from the mutual interaction between CNTs and Pc but also enhance the gas sensing behaviour of CNTs due to the better charge transfer between the composite and gas analytes.

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NANO-14

Band gap and dielectric study of $Zn_{1-x}Ca_xO$ nanoceramics

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Abstract- Calcium doped ZnO ($Zn_{1-x}Ca_xO$) nanoceramics with x = 0 and 0.01 has been synthesized by solid state reaction method. The synthesized samples were characterized by XRD, UV-Vis and impedance spectroscopy. X-ray diffraction study confirms the single phase formation of the samples. The dielectric constant of ZnO decreases with doping. The magnitude of dielectric constant decreases with increase in frequency and the maxima (ε_{max}) shift to higher temperature. Ca doped ZnO sample shows drastic low value of dielectric constant. The dielectric loss spectra of Ca doped ZnO sample shows peak. The band gap of ZnO decreases with doping.The Urbach energy of ZnO increases with Ca doping indicating increase in structural distortion with doping.

Keywords: Doping, XRD, Dielectric constant, band gap

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Influence of Co-Cr substitution on structural and electro-magnetic properties of strontium hexaferrite

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Abstract- Strontium hexaferrite ($SrFe_{12}O_{19}$) is a very popular ceramic magnet. These magnets are widely used in various applications such as permanent magnet, energy transformation drive, computer, telecommunication system, etc. due to their low cost and inertness properties. However, only a limited variety of strontium hexaferrites are commercially available for the development of permanent magnets. So, many researchers are looking forward to see the effect of various elemental substitutions to enhance its properties.
$SrCo_xCr_yFe_{12-x-y}O_{19}$ (x, y = 0, 0.25, 0.50, 0.75, & 1) are synthesised with sol-gel auto combustion method. Subsequently, the powder is calcined and sintered at 1100ºC and 1250ºC, respectively. Phase structure are analyzed by X-ray diffraction (XRD). Sample morphologies are evaluated by scanning electron microscopy (SEM). Variation of dielectric constants and losses with frequency are measured by impedance analyzer from 20Hz to 20 MHz at room temperature. Magnetic properties are determined by vibrating sample magnetometer (VSM). Samples show an increment in saturation magnetization (M_s) with Co^{2+} ion substitution and a relative decrease in M_s with Cr^{3+} ion substitution at the Fe site. For an application point of view, best results are obtained for $SrFe_{11}CrO_{19}$ composition with 59.8 emu/g of M_s and 6.24kOe of H_c.

***Keywords**:* Strontium hexaferrite, Sol-gel auto combustion, Substitution, Magnetic properties, Electrical properties.

Enhanced Physical Properties in Composite Systems

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Abstract- The formation of composites via the mixing of two different materials has the centre of attention for the materials investigation. The composite study in materials is greatly exciting due to the existence of two phases simultaneously. The foremost objective of the composites is the high mixing of two dissimilar materials without inter-diffusion to each other. We have used optimized solid state reaction method to prepare highly insulating materials for the outstanding structural, magnetic, ferroelectric, dielectric and optical properties in the various material combinations such as multiferoric-ferroelectric ($BiFeO_3$-$BaTiO_3$), magnetic-ferroelectric ($CoFe_2O_4$-$BaTiO_3$, $LaSrMnO_3$-$BaTiO_3$) and ferroelectric-magnetic ($BaTiO_3$-$CoFe_2O_4$) etc. [1-5]. These physical properties such as structural, magnetic, ferroelectric, dielectric and optical properties are investigated using powder XRD, Vibrating Sample Magnetometer, PE loop tracer, LCR meter and various optical measurements (i.e., Raman spectroscopy, FTIR and UV Visible spectroscopy), respectively. To conclude our results provide the pure phase and enhanced magnetic, ferroelectric, dielectric and optical properties in these composite systems. These enhanced properties in composite systems possibly can be used in various device applications such as actuators, sensors, resonator, capacitors, spintronics and memory materials etc.

Keywords — Composites, Solid state reaction method, Spintronics

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Study of Dielectric & Mechanical Properties of Rice Husk Reinforced Polymer Composite

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Abstract-Rice is the second most cultivated crops in India. Rice husk is the non-edible constituent of the un-milled rice. Silica is a major component of rice husk, has been already proved to enhance the mechanical properties of various polymeric materials. Besides, improved flame retardancy with the addition of rice husk into polyethylene based composite has also been reported. In addition of rice husk as reinforcing filler for composite panels has been already proposed. The better dimensional stability of rice husk reinforced composites upon exposure to moisture and their higher resistance to termite and biological attack when compare to the wood reinforced composites are added advantages. Employment of rice husk as reinforcing filler for polymeric materials also enables researchers to explore combined reinforcing effect of organic (lignocellulose) and inorganic (silica) components of rice husk. The structural, microstructural, dielectric, mechanical behaviour of this composite are studied and explained. The structural studies were carried out in terms of X-Ray diffraction, FESEM image analysis. The dielectric behaviour of the composite as a function of frequency were studied and the flexural strength and the tensile strength of the composite were observed at room temperature.

Studies onThermal, Morphological and Antimicrobial Properties of hybrid filler LDH/Ag reinforced Starch-g-PVAcBionanocomposite Films

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Abstract:-In the large field of nanotechnology, polymer based nanocomposites have become a prominent area of current research and development.In recent years there is a tremendous expansion of research and technology developments in the field of polymer/biopolymer based nanocomposites.We have synthesized hybrid filler Mg-Al LDH/Ag reinforced Starch(ST)-grafted-Polyvinyl alcohol(PVAc)bionanocomposite films by in situ polymerization method. The prepared bionanocomposite films are systematically characterized by FTIR, TGA, DSC, XRD,Raman Spectroscopy,FESEM, EDS, HRTEMOxygen permeability and antibacterial activity measurement. The interaction between hybrid filler and biopolymer is studied by FTIR.TGA reveals that ST-g-PVAc/LDH/Ag nanocomposite films have more thermal stability over PVAc andST-g-PVAccopolymers. An increase in the glass transition temperature is observed after the incorporation of hybrid filler. The tensile strength of ST-g-PVAc/LDH/Ag bionanocomposite films is improved when filled with 8wt% of hybrid filler,LDH/Ag.The morphology of the bio-nanocomposite films is explored by using XRD, Raman spectroscopy,FESEM and HRTEM. The antibacterial activity of ST-g-PVAc/LDH/Ag bionanocomposite filmsis illustrated to increase with an increase in contact time. The antibacterial activity of bionanocomposite films is enhanced with the incorporation of hybrid filler. Gas permeability measurementdata shows the significant decrease in oxygen permeability value of the ST-g-PVAc/LDH/Ag bionanocomposite films in comparison to the pristine PVAc and ST-g-PVAc. Basedon enhancement in tensile property, thermal stability in combination with significant reduction in oxygen permeability and good antibacterial activities of the synthesized bionanocomposite films indicatefor the packaging applications.

Keywords: LDH, Ag NPs, Bioanocomposites, Morphology, Antibacterial

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Structural and Electrical Characterization of (Bi0.5Pb0.5Fe0.5Ti0.5)O3

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Abstract- According to demand of society, man discovered techniques for producing new materials by tailoring the properties of naturally existing materials by heat treatment and/or by alloying. Here material means the engineering materials, which refers to the materials that are used to produce the products according to the need and demand of technology and society. According to their nature Engineering materials are classified traditionally as (i) Metals and alloys (ii) Ceramics (iii) Polymers (iv) Composites (v) Semiconductors and (vi) Biomaterials. Composite materials consist of more than one material. A composite material is designed to have the best properties of two or more materials used in it. Composite ceramic materials can be defined as inorganic, non metallic crystalline materials processed or used at high temperatures. The composite ceramics usually consist of oxides, nitrides, carbides, silicates, or borides of various materials. Single-phase polycrystalline sample of $(Bi_{0.5}Pb_{0.5}Fe_{0.5}Ti_{0.5})O_3$ was synthesized by a standard high-temperature solid-state reaction method. Preliminary structural analysis of the material using room temperature X-rays diffraction data and pattern exhibits its tetragonal structure. Detailed studies of frequency and temperature dependence of electrical properties of $(Bi_{0.5}Pb_{0.5}Fe_{0.5}Ti_{0.5})O_3$ in the wide range of frequency (10^3–10^6 Hz) at different temperature (25-500° C) have provided many interesting results useful for device applications.. The frequency dependence of ac conductivity of the material obeys Jonscher's universal power law. The results obtained on transport properties of the materials have been interpreted in terms of a two-layer model with conducting grains partitioned from each other by poorly conducting grain boundaries. Based on this model, the two electrical responses in impedance and modulus formalisms have been suggested to investigate the effect of grain and grain-boundary.

Keywords: Multiferroics; electrical properties; XRD; impedance analysis

Fabrication of $0.5(Ba_{0.7}Ca_{0.3})TiO_3$-$0.5Ba(Zr_{0.2}Ti_{0.8})O_3$-PVDF nanocomposites for sensing applications

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Abstract- Ferroelectric materials with Perovskite ABO_3–type structure have attracted the attention of researchers since last fifty years due to their potential applications in capacitors, piezoelectric transducers, pyroelectric detectors and various microelectronic devices. It is observed that most of these materials are made from lead bearing compounds such as $PbTiO_3$, $Pb(Zr,Ti)O_3$, $Pb(Mg_{1/3}Nb_{2/3})O_3$, *etc*. However, there is a worldwide concern nowadays about the toxicity and hazardous effect of lead and lead oxide emanating from these materials during high temperature calcinations and/or sintering. Thus, the need for search of lead-free materials is felt globally. It is observed that a new barium titanate-based ferroelectric ceramic system, $(Ba_{0.7}Ca_{0.3})TiO_3$–$Ba(Zr_{0.2}Ti_{0.8})O_3$ that exhibits a cubic-rhombohedral-tetragonal triple point at MPB (x = 0.50) with high room temperature dielectric constant (ε_r ~ 3,060) and piezoelectric coefficient (d_{33} ~ 620 pC/N). These values are comparable to commercially available soft $Pb(Zr,Ti)O_3$. Further, ceramic-polymer composites are considered to be a relatively new class of functional materials suitable for different industrial applications. Polymers are flexible, light weight and having high breakdown strength, but their piezoelectric strain constant is lower. On the other hand, ceramics have good piezoelectric properties, high dielectric constant and good electrical impedance but are rigid. When combined together, the composites exhibit enhanced piezoelectric properties in comparison to those of electro-active polymers. In this work ceramic ($0.50(Ba_{0.7}Ca_{0.3})TiO_3$–$0.50Ba(Zr_{0.2}Ti_{0.8})O_3$) / polymer (PVDF) nanocomposites in 0-3 connectivity have been fabricated using melt mixing technique and their piezoelectric property (d_{33}) has been measured for possible piezo-sensing applications.

Structural, Morphological and Optical Characterization of ZnONanoparticles Embedded in Zinc Acetate: Effect ofThioacetamide Concentration

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Abstract- Nanoparticles resulted from the interaction of thioacetamide and zinc acetate were probed through structural, morphological and optical studies. XRD characterization indicated the formation of dominant phase of zinc acetate along with the low intensity peak of wurtziteZnO. Morphological transition from bulky like feature to flower like feature is evidenced via sheet like feature with increasing thioacetamide molar concentrations. UV-Visible characterization on the samples indicated the decrease of optical band gap from ~3.29 to 3.24 eVwith increasing of molar concentration from 0 to 30% in the sample. Photoluminescence characterization of the samples showed the shift of emitted color from near green region to blue region with increasing of molar concentration.

Keywords:Nanocomposite, ZnO, UV-Visible, Luminescence

Effect of electromagnetic interaction PVA/Graphite/Barium Titanate for sensor based application

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Abstract-The Electromagnetic properties of the Barium Titanate /Graphite/ poly vinyl alcohol nanocomposites have been studied experimentally and theoretically. Barium Titanate nanoparticles have been synthesized using high Ball milling. For investigation the impact of polymeric matrix on magnetic properties and Piezoelectric properties of nanoparticle, three different composition of Barium Titnate nanoparticle(1%,2%and3%) and Graphite(2%) have been considered for synthesizing the polyvinyl alcohol based nanocomposite by making a thin film. The thin film was prepared by dispersing nanoparticle using ultrasonicator in the polymer matrix and casted. To investigate the effect and nature of nanocomposite were characterized by Scanning Electron Microscope (SEM), Fourier Transform Infrared (FTIR) spectroscopy, and Vector Network Analyzer (VNA) in "x" band such as Reflectance coefficient, Transmittance coefficient and Electromagnetic Shielding measurement. The sample showed a variation range of Shielding value from 12dB to -5dB. Due to increase of Dopant constituent concentration, Polarization also increased. The SEM investigated as decreasing agglomeration and increasing good dispersibility as per decreasing the amount of Barium Titanate nanoparticles concentration. FTIR spectrum revealed that on increasing the concentration of Barium Titnate nanoparticles. This gives positive indication of this thin film sample for sensing devices.

Keyword: Barium Titanate, Graphite, PVA, VNA, FTIR

Synthesis of Gum ghatti-*cl*-P(AAM) hydrogel by $NiFe_2O_4$ nanoparticles and effect of reaction paramenters on the DC electric conductivity response of nanocomposites

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In recent years, conductive nanocomposites have been used in the variety of applications[1-3]. To develop the stable nanocomposites remain a challenge in the field of soft materials due to electrostatic interactions, other dipolar forces induced by nanoparticle and agglomeration of nanoparticle and aggregation of polymer. In this paper, we carried out a facile fabrication of G. ghatti-*cl*-P(AAm) through $NiFe_2O_4$ nanoparticles by simple aqueous graft polymerisation technique. The main aim of this venture was to incorporate $NiFe_2O_4$ NPs into G. ghatti-*cl*-P(AAm) hydrogel and develop conductive nanocomposites. The electric conductive response of nanocomposites has been investigated by optimization of constitutes for comprehensive understanding of various parameters. The incorporation of $NiFe_2O_4$ NPs into the G. ghatti-*cl*-P(AAm) leads to improve the thermal as well as conductive response of nanocomposites. The presence of hydrophilic function groups in the G. ghatti-*cl*-P(AAm) are associated with hydrogen boding with $NiFe_2O_4$ NPs. Therefore, systems become thermally stable and electrically conductive. The $NiFe_2O_4$ NPs formed by simple chemical co-precipitation methods. The characterisation of G. ghatti-*cl*-P(AAm)/$NiFe_2O_4$ and the $NiFe_2O_4$ NPs carried out by FTIR, XRD, SEM and TGA and size of nanoparticle obtained by scherrer's equation which is 4 nm. It was established that nanocomposites hydrogel with electrical conductivity of 3.42×10^{-4} Scm^{-1} which is close to distilled water.

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Processing of graphene foam electrode using low-cost electrochemical method for rechargeable aluminum battery

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Abstract-Despite being the frontrunner in the league of rechargeable batteries, the future of all types of Li-based batteries is critically debatable due to severe declination of Li-based minerals. Considering the possibility of upcoming shortfall, there are global discussions and unprecedented search in both academia and industries for alternative and sustainable battery chemistries based on materials with greater earth-abundance than lithium. A rechargeable battery based on aluminum is envisioned to be a low-cost energy storage platform considering aluminum as the most abundant metal in Earth's crust. However, a rechargeable aluminum battery also requires an electrolyte and a cathode. As a low-cost and green material, graphite is a promising material as cathode in aluminum battery. But it is found that pristine graphite shows poor electrochemical performance. On the other hand, few layer graphene shows remarkable performance. Hence, an electrochemical method is employed to achieve self-standing graphene foam electrodes from graphite foil. These graphene foam electrodes were investigated as cathode in aluminum battery and it demonstrates excellent performance. In this presentation, the electrochemical performance of an aluminum battery with graphene foam electrolyte will be discussed [1].

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Fabrication of energy dense electrode material for faradic pseudocapacitor device using morphologically modified transition metal oxide

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Abstract- We report an improved charge-storage property of TiO_2 through a structural modification from nanoparticles to nanotubes by hydrothermal technique. A typical three-electrode configuration was employed to check the electrochemical properties of the TiO_2 nanotubes, using a suitable aqueous electrolytic medium. Cyclic voltammetry and charge-discharge measurements were performed for both the pristine TiO_2 and morphologically modified TiO_2 at different scan rates and mass-normalized-current values, respectively. For the modified TiO_2, a specific capacitance of ~1400 F/g was obtained at a current density of 7A/g, whereas for the pristine TiO_2, the highest charge storage capacity was recorded as ~400 F/g. Employing Density Functional Theory simulations we have presented electronic and structural properties of TiO_2 electrode for charge storage performance. We have computed the diffusion barrier of K^+ ion of the electrolyte KOH, the accumulated voltage for different K^+ concentration and quantum capacitance of TiO_2 surface. Lower diffusion barrier for K^+ ions and higher accumulated voltage attribute towards superior charge storage performance, which support experimental observations. The detailed analyses are evident of the fact that we could bring significant enhancement to the charge storage capacity of TiO_2 nanostructures by modifying their morphology.

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Hydrothermally synthesized Chalcopyrite as electrode material for supercapacitors

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Abstract- Transition metal chalcogenides has gained much attention for the energy storage applications. In this work, a novel Chalcopyrite ($CuFeS_2$) platelet like open pored micro flower structure was fabricated using hydrothermal method and investigated their electrochemical performance as an electrode material for supercapacitors. First and foremost, the structural, morphological, vibrational, and chemical compositional characteristics of the as prepared $CuFeS_2$ was investigated by X-ray diffraction (XRD), field emission scanning electron microscope (FESEM) with elemental mapping, laser micro Raman, and X-ray photoelectron spectroscopy (XPS), respectively. Subsequently, the electrochemical properties of the $CuFeS_2$ electrode were explored using cyclic voltammetry (CV), galvanostatic charge-discharge (CD), and electrochemical impedance spectroscopy (EIS) studies in 1.0 M LiOH electrolyte. The cyclic voltammetry and charge discharge analysis reveal the pseudocapacitive nature of $CuFeS_2$ electrode by obtaining maximum specific capacity of 26.46 mAh g^{-1} at a scan rate of 5 mV s^{-1} with cycling stability of 94.38 % even after 2000 cycles at a current of 5 mA. Further, in the view of practical application a symmetric supercapacitor device was fabricated using $CuFeS_2$ electrode and which, delivered a maximum specific capacitance of about 34.18 F g^{-1} at the current of 1 mA and a maximum energy density of about 4.74 Wh kg^{-1} with excellent cyclic stability. The acquired results confirmed that $CuFeS_2$ electrode could be a prospective and electrochemically active candidate for next generation supercapacitor.

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Multilayer nanoplatearchitectured Bi-metallic Oxide as an Electrode Material for High-Performance Supercapacitor Application

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Abstract- The worldwide concern of energy evolution, notable technological trend, overconsumption of energy, deterioration of the ecological world, and day to day lives electronic world have triggered intense scientific research to explore sustainable, eco-friendly, clean and green energy storage devices. Although a lot has been attained in this direction, high energy density and long cycle performance are still a challenge and need more and more modification of the advanced energy storage devices. For the supercapacitor study,herein, we have fabricated the nanostructured bimetallic oxide based electrode. The $NiCo_2O_4$/Ni deposition occurred through the hydrothermal route and subsequently followed by the heat treatment for the consistent growth of nanostructured $NiCo_2O_4$. SEM and XRD analysis studied morphology and physiochemical composition of the electrodes. The SEM images of the $NiCo_2O_4$/Ni electrode confirmed the constant development of nanoplate-designed bimetallic material over the Ni surface. Electrochemical impedance spectroscopy, cyclic voltammetry, and galvanostatic charge/discharge tests evaluated the electrochemical behavior of the electrodes. The as-fabricated electrode exhibited better electrochemical performance. The results highlight that nanoplate architecture's constructionreveals better performances, which is mainly due to the large active area and direct contact between the electroactive materials and metal current collectors. Further, the present results demonstrate that the binder-free electrode designing approach has excellent potential in energy storage devices.

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Fabrication of Three-Dimensional NiCo-MOF Electrode Towards the Performance Improvement of Hybrid Supercapacitors

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Abstract- The realization of sustainable energy storage devices demands high power density and appreciable energy density [1]. In connection to this, hybridization of both supercapacitor and battery type electrodes is an effective strategy [2]. Herein ternary metal oxide ($NiCoO_2$) binder-free electrode was grown over nickel foil via hydrothermal synthesis. Further, a bimetallic metal-organic framework (NiCo-MOF) was designed over the $NiCoO_2$ via solvothermal method as a performance augmentation step. The structural and morphological characterization of the as-prepared $NiCoO_2$ andNiCo-MOF@$NiCoO_2$ electrodes were analyzed via X-ray diffraction (XRD) and scanning electron microscopy (SEM). The electrochemical performance of both the electrodes was scrutinized via cyclic voltammetry (CV), galvanostatic charge-discharge (GCD) and electrochemical impedance spectroscopy (EIS) tests. Both of the as-prepared electrodes revealedbattery-type behavior. The electrodes' specific capacity was calculated from both CV and GCD profiles and compared with each other. The maximum specific capacity achieved by the $NiCoO_2$ electrode was 1687.5 mC/cm^2 ata current density of 4 mA/cm^2 but with an inferior rate capability of only 34.84% after the current density of 20 mA/cm^2.On the other hand, the NiCo-MOF@$NiCoO_2$ electrode delivered the highest capacity value of 1376.0 mC/cm^2 at a current density of 4 mA/cm^2 with an enhanced rate capability of 69% after the current density of 20 mA/cm^2. The rate capability of the NiCo-MOF@$NiCoO_2$ electrode was nearly two times the $NiCoO_2$ electrode. This result emerges the bi-metallic NiCo-MOF as a next-level sustainable hybrid supercapacitor electrode.

Keywords: Bi-metallic MOF, Hybrid Supercapacitor, Rate Capability, Binder-Free

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Flower-like Three-dimensional CoMn-LDH Nanostructure Electrode forElectrochemical Supercapacitors

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Abstract-Flower-like 3D-CoMn-LDH nanostructures on nickel substrate were fabricated by a facile hydrothermal route and further examined as the binder-free electrode for high-performance supercapacitors. The as-prepared electrode was characterized by X-ray diffraction, field emission scanning microscopy, energy dispersive X-ray analysis and X-ray photoelectron spectroscopy. The XRD pattern confirmed that the flower-like 3D-CoMn-LDH nanostructures were crystallized in the cubic phase. FE-SEM images showed a flower-like structure for CoMn-LDH, which were uniform and densely covered on the nickel substrate's surface. The electrochemical studies of cyclic voltammetry, galvanostatic charge-discharge, and electrochemical impedance spectroscopy tests were also carried out to assess the binder-free electrodes' capacitive properties. The as-prepared binder-free CoMn-LDHnanostructure electrode displayed excellent output results of areal capacity and long-term cycling stability. These observed better electrochemical performances suggest that the binder-free flower-like 3D-CoMn-LDH nanostructures on the nickel substrate aresuperior electrode material for high performance electrochemical supercapacitors. Moreover, the high electrochemical behavioris based on strong achieve the force of self-assembled three dimensional nanostructures and current collector to allow rapid ion transportation.

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Studies on structural, thermal and ionic conductivity in crystalline polymer electrolytes for lithium ion batteries

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Abstract-Polymer electrolytes (PEs) are an essential component being used in most energy storage/conversion devices. Polymer electrolytes are the subject of intensive study, in part because of their potential use as the electrolyte in all-solid-state rechargeable lithium batteries. These materials are formed by dissolving a Li_2SO_4 salt in a solid host polymer such as poly (ethylene oxide), and be prepared by using solution casting method. The structural properties were examined by XRD studies. The variation in film morphology is examined by scanning electron microscopy (SEM) micrographs indicated that the lithium salt particles were dispersed and embedded well within the polymer matrix. The absorption spectra were measured in the wave range from (200-800) nm at 303K. The optical band gaps (E_g) for allowing direct transition decrease to increase the concentration of lithium sulfate. The optical activation energy was evaluated using Urbach-edges method. The thermal properties of these films were investigated by differential scanning calorimetry (DSC). The emission spectrum of the PEO emerged at 359nm. The 50wt% showed an emission peak at 384nm, 25nm red-shifts than that of the PEO. The rise of the conductivity is significant with increased concentration of Li_2SO_4; this is meant the decrease in the degree of crystalline and increase in the degree of amorphosity. This suggests that, Li_2SO_4 is a good dopant to improve the electrical properties, the maximum conductivity was found to be 2.25×10^{-5} S/cm.

Keywords: Polymer electrolytes, XRD, optical energy gap, clusters, SEM, conductivity, thermal stability.

Review on Cold Spray as a Surface Modification Technique for Artificial Hip Joint

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Abstract- Synovial joints like hip and knee works as a tribological system in humans. The hip is a tribological joint where the upper part of the femur i.e., femoral head separates the lower part of the pelvic i.e. acetabulum by a synovial fluid cavity. Synovial fluid helps in lubrication between the contacting surfaces and also helps in supporting the load carried by the bones. The ends of these long bones are supported by a tissue called cartilage. Cartilage helps to support the load carried by the bones at the joint and helps to provide lubrication between the contacting surfaces. Hip joint is one of the most important joint when it comes to load carrying capacity. However, it may fail in some adverse conditions like abnormalities of joint, transmission of excessive load, arthritis and in some accidental injuries. The common reason is beloved to be the failure of cartilage caused by arthritis. Once a cartilage fails there is no promising solution to recover it. However, there are some temporary solution such as non-steroid anti-inflammatory drugs or Intra-articular Steroids Injections (IASI) which are available in the market that may sometimes help to save the joint for few months. The other solution is hip implantation.

One of the major problems facing by the biomedical industry especially the hip implant industry is the lack of desired mechanical properties of the materials to be implanted which are compatible to the human body environment. This causes several problems such as implant loosening, osteolysis, Alzheimer etc. Stress shieldingdue to the difference in elastic modulus of the implanted material and the bones is one of the major problems. Other problems are wear, corrosion, and biocompatibility of implanted materials. Surface modifications of the implanted materials has been shown to help resolve these issues. Number of techniques have been used by the researchers. Thermal spray is one of the most widely accepted coating techniques to modify the surface of implants in terms of their mechanical properties and corrosion behaviour. Thermal spray is a coating techniques which utilizes high velocity and temperature to deposit a material over base material in order to enhance the overall performance of the base material. However, high processing temperature in thermal spray create many problems, one of them being the phase change in the coating materials. This problem is further nullified by using cold spray; Cold spray is a solid state deposition coating technique utilizing low processing temperature that is far below the melting point of the coating materials. Hence, temperature sensitive materials like titanium and hydroxyapatite can be sprayed without any phase change. Focus of our research work is to develop a novel coating to enhance the tribological, biological and mechanical properties of hip implant. Some trials have already been conducted of depositing biomaterials.

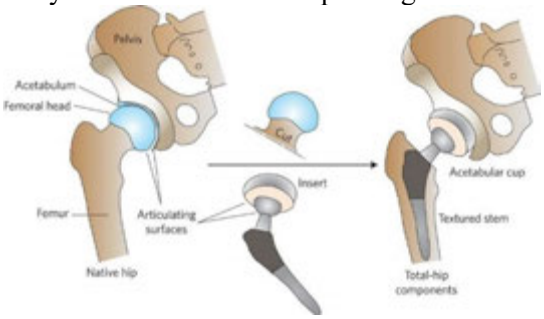

Fig. 1 Native hip joint replaced with ball and socketimplant.

High chromium cast iron filler metals: an Industry 4.0 approach

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Abstract- High chromium cast irons are widely used as wear resistant materials. They consist of carbide precipitates in a eutectic matrix of carbide and austenite. Performance depends on the type, hardness, morphology, distribution, volume fraction and orientation of the crystallysed carbides within their microstructures, as well as on the nature of the matrix supporting these carbides

Welding Alloys has taken on board an Industry 4.0 approach using the latest computational modelling to optimise and harmonise the high chromium cast iron range of consumables. Information from the literature and from historical experimental data taken from Welding Alloys Group were combined into a large database.

By combining fundamental thermodynamic principles, expertise on high performing microstructures and neural networks, a model was developed. The new model is capable to predict optimised potential formulations for the new generation of hardfacing welding consumables. Model validation data will be presented and discussed.

Halogen-Free Imidazolium Based Surface active Ionic Liquid: Micellization Behavior, Surface Parameters, and Antimicrobial Activity

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Abstract: In the emerging importance of ionic liquid in colloidal interface science, therapeutic applications, and surface sciences, we report the two 'Halogen-free' methyl carboxylate, imidazole based Surface active ionic liquids. ^{1}H-NMR and IR confirmed the success of the synthetic method. The micellization behavior was determined by conducometer, surface tension, and fluorescence quenching techniques. Thermodynamic data for SAILs were compared with traditional surfactants resulting in an entropy-driven process. The surface parameters of the new SAILs were adequate as they reduce surface tension and increase the surface excess concentration. The fluorescence quenching calculated the aggregation number of SAILs with the help of benzophenone as a quenching material. The SAILs have antimicrobial activity against the gram-positive and gram-. Minimum inhibition concentration (MIC) values for gram-positive were lower than gram-negative, as verified by three sets of optical density results.The studies showed an increase in the alkyl chain in the anion corresponds to an increase in the antimicrobial activity.

Experimental and Simulation Studies of DEASA (Dayalbagh Educational Air Shower Array) based on 'Hands-on-LearningTeaching-Research 'Model using CORSIKA, GEANT4 and ROOT tools for undergraduate students.

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Abstract- The Dayalbagh Educational Institute has funded the setting up of DEASA (Dayalbagh Educational Air Shower Array) an air shower array of eight detectors of 1m x 1m x 2 cm in collaboration with Cosmic Ray Laboratory (CRL), Ooty, Tata Institute of Fundamental Research, Mumbai. The mini detector array has been designed, assembled and electronics connected with each detector by the students in Nuclear physics laboratory.The studies are based on Linsley effect which "measures the spread of the arrival times in particle samples and makes it possible to estimate the distance to the shower axis" (**A.A. Radu et al, Romanian Reports in Physics, Vol. 60, No. 1, P. 45–55, 2008**). After the 1940's theoretical and experimental studies had established that an air shower has nuclear and electromagnetic components. At present with 70 years of accelerator-based research, the cosmic rays still give us the lead to understand the high energy interactions. Even after 107 years from their discovery, cosmic rays are being studied through experiments all over the globe. An interesting fundamental observation of the "neutron thunder" is now added to our knowledge of these energetic particles which needs to be further studied (**A.D. Erlykin, Astroparticle Physics 27,2007**).

The international ground-based arrays are KASCADE, AGASA, PIERRE and national experiments coming are INDIGO, INO, India's SPACE STATION and GRAPES3. The aim of our set-up experiment is to make the students skilled in the basic techniques required for these experiments. Instead of theoretical learning and discussion of their results, the author has designed hands-on-learning sessions with the undergraduates and post-graduates of Faculty of Science. The author has students involved in basic studies of the muon telescope which was built by the students at CRL, Ooty, setting up the NIM based electronics, data taking, analysis, Geant4 based Monte Carlo simulations. The next task is to do the air shower studies in the same manner with a mini detector array. "According to Boyer Commission model the scholar-teachers treat their research sites as seminar spaces open to undergraduate and post-graduate students, where regardless of academic level, all can practice their research skills and help develop others' proficiency" (**S. Guatelli et al., Transferring Advanced Physics Research Tools to education, Proceedings of INTED2010 Conference, Spain**).

The experiment shall be the "Showers of Knowledge bringing the users globally together to the analysis of metadata accumulated in real time of the studies done. This will study the basic fundamentals in science (**L. Baldini," Space based Cosmic Ray and Gamma Ray Detectors: a review" arxiv:1407.7631v2**) more accessible and encouraging for the internet users and students". The endeavor will reduce the bridge between the research in modern science and the skilled levels of the society. The targets shall be the high school, undergraduate, post-graduate students and the keen global users. The cosmic rays are a relevant platform for a basic understanding into the techniques of modern science like experimental set-up, data taking, analysis and simulation.

Bio based Automobile paint: A new era of research

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Abstract- Automobile paint is always an emerging field in research. Normally the automobile paint is polyurethane based and is applied as three layers, primer, base coat and clear coat and base coat is the most important layer of paint. But the polyurethane used is in general derived from petroleum based polyols and as petroleum is a non renewable source, alternative sources are now the need of time. In this research project bio based castor oil is used as polyol to synthesize the polyurethane to be used in base coat. First the castor oil is epoxidised with formic acid and hydrogen peroxide in nitrogen atmosphere. Then it is used to synthesize polyurethane and IPDI is used as the curing agent. To improve the properties 0.5wt% of nano silica is added to the paint. After that tests like TGA, FTIR, Abrasion, Gloss, acid test, base test, engine oil test, adhesion test, petrol test, diesel test are done and all the test results are compared with commercial paint for comparison.

Synthesis, Spectral, Hirshfeld Surface Analysis, DFT Calculations and Molecular Docking Studies on Dioxol Derivatives as Potential Antibacterial Inhibitors

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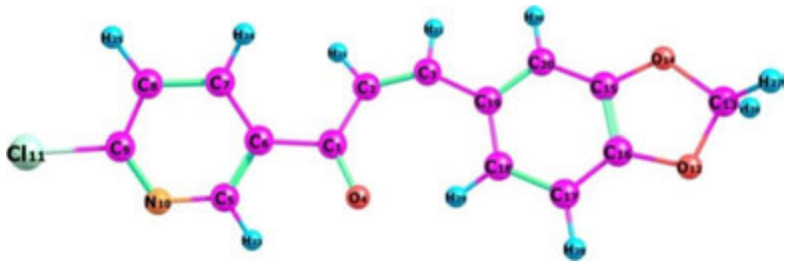
Abstract- The title compound (2Z)-3-(2H-1,3-benzodioxol-5-yl)-1-(6-chloropyridin-3-yl) prop-2-en-1-one has been synthesized and single crystals were grown by slow evaporation solution growth technique at room temperature. FT-IR, Raman, UV and NMR spectra of synthesized compound in the solid phase were recorded and analyzed. The optimized geometry and vibrational wave numbers were computed using DFT method. The NLO, Mulliken, MEP, HOMO-LUMO energy gap and thermodynamic properties were theoretically predicted. The hyperpolarizability calculation reveals the present material has a reasonably good propensity for nonlinear optical activity. The NBO analysis explained the intramolecular hydrogen bonding. The global chemical reactivity descriptors are calculated for compound and used to predict their relative stability and reactivity. Hirshfield surface analysis and Fukui functions calculation were also performed. All the calculations were carried out by B3LYP/6-311++G (d,p) method using Gaussian 09. The antibacterial and antifungal activity of the compound was also tested against various pathogens. The molecular docking studies concede that title compound may exhibit antibacterial inhibitor activity.

Keywords: DFT, FT-IR, FT-Raman, Molecular docking



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BIOM-02

Design and characterization of a Cu(II) coordination polymer based on a-diimine: Evaluation of the biomimetic activity

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Abstract- The copper-based polymer was synthesized using slow evaporation method using α-diimine chelator (1,10-phenanthroline) as the primary ligand. The synthesized polymer was characterized using various spectroscopic studies (FTIR, UV-visible, EPR, luminescent) PXRD and TGA techniques. The single crystal X-ray crystallographic studies reveals the molecular structure of complex to be a one dimension (1-D) coordination polymer (CP) with the composition $[Cu(phen)(NO_3)_2]_n$. Further FTIR spectrum of CP ascertains the binding modes of the ligand moiety. The Cu(II) ion is present in +2 oxidation state and the geometry around the central metal ion is distorted square pyramidal. The central metal ion in CP is penta-coordinated having the geometry intermediate between distorted square pyramid and TBP with Addison parameter = 0.33. Moreover, CP shows a brilliant catecholase-like activity in methanol which can easily oxidize the substrate 3,5-di-tert-butylcatechol (3,5-DTBC) to its respective quinone. Kinetic measurements suggest that the rate of catechol oxidation follows saturation kinetics with respect to the substrate and first order kinetics with respect to the catalyst. The CP shows a very good catalytic activity with $K_{cat} = 8.28\ h^{-1}$.

BIOM-03

Thermodynamic prediction of bulk metallic glass forming composition in Zr-Cu-Fe-Al system and understanding the role of Dy addition

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Abstract: In the present investigation, we propose a theoretical approach to the design of the Zr rich glass forming composition in the Ni-free Zr-Cu-Al-Fe quaternary system under the thermodynamic framework. In this approach quaternary composition is determined by optimising chemical interaction and atomic mismatch between constituent elements quantified in terms of enthalpy of chemical mixing (ΔH_{chem}) and mismatch entropy ($\Delta S_{\sigma}/K_B$) in a statistical designed configurational entropy ($\Delta S_{conf}/R$) range in the ternary systems. Further effect of Al, and Fe addition in the Zr-Cu system on the glass forming ability (GFA) analysed in terms of thermodynamic factors. Additionally in this investigation as attempted has been made to understand the thermodynamic effect of micro-alloying of Dy in the Zr-Cu-Al-Fe system on the GFA.

BIOM-04

Docetaxel incorporated ZnO/PCL nanoscaffold biosensor for lung cancer diagnosis and treatment

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Abstract: Clinical evidences show that recurrence of lung cancer cells is the predominant reason for penurious survival rates.In this scenario, use of nano bio technology can circumvent the demerits associated with traditional cancer treatments.Drug and nanoparticle incorporated electrospun nanofibers proves to be a promising area effectively serving to defend the recurrence of cancer cells because of its high surface area , enhanced cytotoxicity and apoptotic activity.In this study,we report the fabrication of docetaxel doped zinc oxide nanoparticles decorated polycaprolactone nanofibers for its promising effects against A549 lung cancer cells.We have adopted a response surface methodological design named central composite design to optimise the parameters for electrospinning.The nanofibers fabricated by electrospinning technique are also characterised by SEM for their morphology,XRD to confirm their semi crystalline nature and FTIR spectroscopy for their chemical bonding.HPLC was also carried out to study the retention time of the incorporated drug docetaxel which is found to be around 11.7 minutes . Further , MTT results showed provoking toxicity percentage against A549 lung cancer cells wherein the cell viability percentage was around 20.47% at 500µg/ml. Acceptable hemolysis percentage less than 5% was also observed for our nanofibers highly demonstrating its bio compatibility to the surrounding normal cells.Most evidently an apoptotic mode of cell death was observed for the fabricated nanofibers showing exceptional effects against A549 lung cancer cells which is confirmed from our flow cytometry analysis.Thus our fabricated nanofibers proves to be a convinvcing material due to incorporated zinc oxide nanoparticles and drug docetaxel serving for enhanced degradation and improved cytotoxicity to A549 lung cancer cells encapsulated inside polycaprolactone nanofibers exhibiting steering effects in the field of synthetic biology.

BIOM-05

Custom-made Bio-nanocomposite Injectable Scaffolds to Engineer and Regenerate Bone Tissue

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Abstract: Considering that, the current, clinical treatments for orthopaedic injury often involve surgical interventions to remove defective tissues and use of preformed scaffolds as replacements, leading to long-term complications, injectable hydrogel scaffold promises to be the alternate for traditional scaffolds. To this end, we have developed nanocellulose enabled bio-nanocomposite injectable hydrogel scaffold that can be injected through a syringe to the defect site. Additionally, the hydrogel scaffold has the unique ability to reassemble at the targeted area within a short interval and start recovery in bone formation. A biomimetic approach has been used to incorporate nanocellulose (NC) fibrils within poly-(vinyl alcohol) (PVA) matrix to develop the injectable hydrogel scaffolds. The hydrogels were formed using physical crosslinking process involving multiple freeze-thaw cycles. A range of bio-nanocomposite hydrogels were prepared with varying concentrations of nanocellulose. To induce bioactivity and systematically control the porous microarchitecture and hydrolytic stability of the injectable nanocomposite hydrogel, we have incorporated novel nanofluourcanasite (n-FC) within the matrix. Investigation of micro-structural surface topology was carried out using scanning electron microscopy, which indicated reduced surface perturbations, while, Fourier transform infrared spectroscopy studies indicated presence of characteristic functional groups and their possible interactions. Enhanced structural integrity and dynamic stability of the bio-nanocomposite hydrogels were also confirmed by carrying out rheological investigations at different frequency, amplitude, temperature and time sweeps. Further, the bio-nanocomposite injectable hydrogels demonstrated excellent injectability and self-standing behavior.

Keywords: Bio-nanocomposite; Injectable Hydrogel; Scaffold; Nano-fluorcanasite; Poly(vinyl alcohol); Nanocellulose.

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GREN-01

Synthesis of a newly designed CT complex of electron donor with acceptor and exploring its sensing ability

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Abstract: A charge transfer complex (CTC) was synthesized and characterized by various methods (FTIR, UV-vis spectroscopy and TGA/DTA). The crystallization of CTC was done through slow evaporation method. Single crystal X-ray diffraction was obtained and occurrence of hydrogen bonding through transfer of aromatic hydrogen atom from acceptor moiety to the nitro groups of the donor moiety was evident. Various thermodynamic and physical parameters were evaluated using UV-visible spectroscopy and Benesi-Hildebrand equation The interaction donor and acceptor was visualized via N^{+}—H---O^{-} hydrogen bonding. This CTC chemosensor shows a highly selective fluorescence quenching response towards 1,3-dinitrobenzene over other nitro explosives and Fe^{2+} ion over other metal ions. A noticeable color difference can be seen between Fe^{2+} and Fe^{3+} by the naked eye. This discriminative detection of two states Fe ion was also observed in human deoxyhemoglobin (HHb) and oxyhemoglobin (HbO_2). The static and dynamic quenching mechanism of sensing was explored through various methods (Dexter electron transfer and Forster-resonance energy transfer).

Keywords*:* Charge transfer; SC-XRD; Fluorescence; Chemosensor; TGA/DTA; UV-vis spectroscopy.

GREN-02

Promoting the use of cement-less building materials with industrial wastes: efforts of Green Tech Concrete and Research (GTCR) for a sustainable future

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Abstract-The conventional cement production process not only causes huge carbon emissions, but also consumes massive amount of natural resources and energy. It is estimated that, for 1 ton of Portland cement, approximately 4GJ of energy is consumed, and 1 ton of $CO_2$is emitted to the atmosphere. Considering the increasing demand for building and road infrastructures, a huge demand is anticipated on the cement production in near future. On the other hand, the global warming and climate change are occurring in unprecedentedly and it is obvious that the cement industries are also plays a great part, since they alone contribute 7-8% of the total CO_2 emission. Henceforth, several efforts have been made to develop cement less concretes and building materials to minimize the environmental concerns imposed by cement industries. Joseph Davidovits was the first to invent a class of inorganic polymers (geopolymers) that have cementing property as like conventional cement and can be made from industrial wastes instead of natural ones. This geopolymers can be prepared by activating industrial wastes such as fly ash (FA), blast furnace slag (BFS), rice husk ash (RHA) etc. with alkaline liquids, and have similar or even better performance in some cases (sulphate and acid resistance) than the conventional cement based building materials (concrete, plaster, blocks, road materials etc.). With time, geopolymer emerged as one of the sustainable replacement of conventional cement based materials, since it helps to utilize the industrial wastes in bulk and also solves the problems associated with cement production. Counties like Australia has commercialized this, and using this material for its infrastructure developments. Though the geopolymers are more cost effective in long run, but they need high initial cost as compared to the cement based materials. This cost is generally imposed by the high cost of alkaline activators, as the waste materials (FA, BFS etc.) are freely available. Hence, counties like ours (India) is unable to use this material due to high initial cost as compared to conventional cement based materials. Therefore, a new method to prepare an alternative alkaline activator was developed to produce low cost cement-less building materials. In this method, rice husk ash (RHA) which is a waste generated from rice mills was used to produce a special chemical activator to produce geopolymers, which have similar performance as like conventional one. The compressive strength of this new material ranges in between 45-55 MPa by 28 days of atmospheric curing (no water is required for curing like cement based materials). This innovative method can be used to produce cement-less building materials like concrete for structural applications in both buildings and roads, concrete blocks for masonry, paver blocks for pavement applications, tiles for flooring, and many more at a very reasonable cost. An Indian patent application is also filed on 14th October 2019 to protect this invention having application no-201931041466. To implement and commercialize this new green technology, an organization is formed named as Green Tech Concrete and Research (GTCR) which is in the process to be established soon. Since, the need for paving materials (paver blocks) for footpaths in cities and tile for flooring are increasing with rapid urbanization, GTCR will manufacture these building materials in the first phase soon in the early of 2021. The cost of these cement-less building materials is expected to be less than the cement based materials with other additional advantages like low environmental impacts, waste utilizations and low water consumption.

GREN-03

Environment-friendly nanoporous oxygen-deficient $NiFe_2O_4$ based Hydroelectric cell

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Abstract- Hydroelectric Cell (HEC) is one of the emergingdevices which produce green energy. In the device fabrication of HEC, a Zn plate has been used as anode, Ag paste as the cathode, and the material as an electrolyte. In this direction, we synthesised a nanoporous $NiFe_2O_4$ using the solid-state reaction method. $NiFe_2O_4$ pellets were sintered at two different temperatures, 950°Cand 1050 °C, for two hours. It was found that the maximum current output of $NiFe_2O_4$ based HEC decreases with an increase in the sintering temperature (leads to grain growth). This grain growth reduces nano-porosity and the number of defects in the material, which are the vital parameters for the separation of physisorbed water molecules. X-Ray diffraction analysis confirms the phase formation as cubic spinel. The Field Emission Scanning Electron Microscopy (FESEM) micrographs were used to analyse the morphology of the materials. Energy-Dispersive X-ray analysis confirms the elemental composition of the materials. The V-I polarization curve of $NiFe_2O_4$ based HECs provides a maximum current output of 15.3 mA for the samples sintered at 950 °C, and 9.28 mA for the one sintered at 1050 °C. Variation in oxygen vacancies with sintering temperature was analysed after the peak fitting of O1s spectra, which was obtained from the X-ray Photoelectron Spectroscopy.

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GREN-04

Design and development of sole out of vegetable and fruit waste

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Abstract- In today's world the footwear industry is leading a way for the development. The main and sole purpose of this vegetable waste sole is to reduce the pollution that is caused by the present soles running in trend. The present sole is mainly based on PVC,PV,EVA,TPR which are the polymers which causes a lots of pollution in many forms such as land pollution, water pollution, air pollution when such polymers are burnt some toxic gases are released and the climatic changes occur on the earth. The above mentioned soles are also non-biodegradable which causes the land pollution. We can see in the today's generation the whole waste is thrown into the seas in which the footwear waste contributes to its extent. To reduce this pollution in any means and to control the waste management system of footwear materials the sole made of vegetable waste which can be purely made of organic and easily degradable material without diminishing the quality of the sole.

The main purpose of the sole is the vegetable waste which consists of Vegetable wastes including the rotten, peels, shells, and scraped portions of vegetables or slurries. The vegetable waste consists mainly of thrown out waste by the vegetable sellers in the markets. In India the vegetable waste is simply collected by the garbage collector and thrown out in the dump yard, but if we use precisely the waste of the vegetable we can convert it into the organic sole which can be easily degradable. The recent waste in India is recorded as 16% of the vegetable and fruit waste. To convert this waste into an organic substance we can make the organic sole made out of vegetable and fruit waste. We can observe daily the vegetable and fruit waste is simply thrown into the garbage and later into the dump. To minimize the pollution and the waste of vegetable and fruit we can make the sole out of it which becomes degradable i.e., which can be successfully converted into a organic fertilizer further that can be used in the Agro department. The sole which we use for making uses the vegetable and fruit waste and after the completion of the usage of sole we can use the same upper under some type of special construction in footwear, we can use the new sole for the same upper and the torn out sole can be further processed into orga-fuel or fertilizer through fermentation under composting. Due to this we can minimize the pollution caused through air, water, land and which can be converted into a useful successful product which has many types of organic uses not causing any damage to the environment

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GREN-05

Study and Development of Bio-degradable Shoe Sole materials in simulated compost environment

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Abstract- The term biomaterial is used for materials used in medical implants, extracorporeal and disposable devices, and must have compatible biological, physical, chemical and mechanical characteristics for use in humans. Medical researchers are seeking innovative manufacturing methods to produce healthcare products alike; prosthetics, implants, diabetic foot care Product, etc., faster and more accurately. This research focuses on exploring the current technical challenges and provides a unique solution through additive manufacturing method in the development of customized sole. When it comes to the industry of footwear, the materials and components used also play a major role in polluting the earth. For example, highly used materials like leather, PVC, PU, are extremely polluting and take a long time to degrade. Materials like this greatly affect the natural ecosystem which starts a chain of unfortunate events which eventually ends in irreversible damages to the environment. Hence of the solution of this problem this projects works to create the sole which is completely degradable in the soil. This is likely eco-friendly to the environment.
According to the human anatomy foot is important part in the body, so as a human everyone should take care about the foot and also the environment which is important aspect in the future. Till now in the industry of the foot wear the major using chemicals are damaging the environment and also the product is taking years to degrade in the soil. So these are going create a huge problem in further generations, Right now the awareness for using biodegradable and renewable sources is getting stronger as humans understand what is happening to our home. It is high time that the same comes to the footwear industry too as is it a necessity. Not a privilege

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Design of MIMO Antenna – Creating a model for the smart IOT School

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Abstract- This paper going to represent the rapid development of 5g MIMO Antenna and how that going to create a model in the development of "**The Smart internet of things school**". This technology will helping to automate IT Networks, Safety and Security , Energy, Healthcare, Retail, Transportation and Industrial.
To reduce Traffic intensity globally MIMO Antenna will increase the performance of 5g network and to improve wireless communications. CMA is widely used for antenna design, placement and integration where Mobile antenna is designed to operate in the LTE-1.8GHZ band. CMA is used to calculate modal currents on a surface reserved for the antenna. ECC lower than 0.15.Tolal efficiencies higher than 40% and isolation lower than 10db.Thia antenna widely designed to automate LTE-communication and to increase more connecting devices also provide good isolation between devices. Frequently used 5g antenna countries for IOT and smart city are South Korea, Japan, China and USA for getting better speed and high capacity wireless communications. By developing such 5g antenna involves massive information exchange and high data rate transmission.

Keywords- 5g-MIMO, IOT School, CMA, Performance of 5g.

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Enhancement of dielectric behaviour of Cerium doped 0.92 ($Bi_{0.5}Na_{0.5}TiO_3$) - 0.08 ($BaTiO_3$) ceramic

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Abstract- The present manuscript highlights the structural, dielectric and conduction behaviour of cerium modified 0.92 ($Bi_{0.5}Na_{0.5}$)TiO_3- 0.08$BaTiO_3$(abbreviated as BNT-BT) lead-free ceramics. Ce_2O_3 (3wt%)-doped 0.92 ($Bi_{0.5}Na_{0.5}$)TiO_3- 0.08$BaTiO_3$lead-free piezoelectric ceramics was synthesized by conventional solid-state reaction. X-ray diffraction (XRD) patterns indicated that Ce_2O_3 has diffused into the lattice of BNBT8 ceramics and formed a solid solution with a pure perovskite structure.The frequency dependent dielectric properties at room temperature reveal that the dielectric constant increases up to3wt.%. The temperature dependent dielectric study shows that the phase transition temperature does not change much but the maximum dielectric constant increases and the dielectric loss decreases.The ac conductivity was obtained from the impedance measurements, which shows that the conductivity increases with incorporation of Ce in BNT-BT ceramic. The activation energy obtained from the Arrhenius equation shows that the activation energy reduces with incorporation, which implies the reduction of oxygen vacancies. The enhancement of high dielectric constant, reduction of dielectric loss makes the Ce modified BNT-BT ceramic, suitable for high temperature industrial application.

Keywords: Solid-state reaction, X-ray diffraction, dielectric properties, Conductivity

Synthesis and Characterization of La modified Double Perovskite $Sr_{1.9}La_{0.1}FeMoO_6$

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Abstract- Researches had developed a new promising double perovskite material Sr_2FeMoO_6 (SFMO) exhibiting an appreciable low field magnetoresistance at room temperature. The origin of which was associated with its half metallic band structure and a high Curie temperature of 420 K. SFMO exhibited a large low field tunnelling type of magnetoresistance (TMR) not only at low temperature but even at room temperature. The physical origin of which is reasoned by the half metallic behaviour of the compound [4]. These properties arise from the combined effect of an electronically more localized 3d ion of Fe with a more delocalized 4d ion of Mo. There arose problems while explaining the magnetic and the electronic behaviour of the material.
Polycrystalline samples of La^{3+} modified double perovskite compound Sr_2FeMoO_6 were prepared by a high-temperature solid-state reaction route. X-ray diffraction of the $Sr_{1.9}La_{0.1}FeMoO_6$ ceramic powders confirmed the tetragonal structure of the compound and the presence of a small amount of $SrMoO_4$ as impurity. The cell parameter a, c and the volume of the polycrystalline sample increased with the La doping. The addition of the charge carriers reduced the magnetization effects and enhanced the electrical properties of the oxide. Detailed studies of frequency dependence of dielectric and electrical properties of $Sr_{1.9}La_{0.1}FeMoO_6$ in the wide range of frequency (10^3–10^6 Hz) at room temperature have provided many interesting results useful for device applications. The dielectric parameters and the impedance reduced with frequency. The frequency dependence of ac conductivity of the material obeys Jonscher's universal power law. The results obtained on transport properties of the materials have been interpreted in terms of a two-layer model with conducting grains partitioned from each other by poorly conducting grain boundaries.

Keywords: Double perovskite; electrical properties; XRD

Investigation of conduction mechanism in Bismuth doped Barium Tiatanate ceramic: An impedance spectroscopy analysis

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Abstract- The present manuscript report the conduction mechanism of Bismuth (Bi) doped barium titanate ceramic. Different concentrations (x=0.0, 0.01, 0.025 and 0.05) of Bi substituted $BaTiO_3$ (BT) ceramic were prepared by solid-state reaction route with general formula $Ba_{1-x}Bi_{2x/3}TiO_3$. The structural, micro structural and impedance properties were investigated for different Bi concentrations. The X-ray diffraction pattern shows the single phase tetragonal structure with a space group of P4mm for all concentrations of Bi. The SEM images shows a compact and homogeneous grain distribution with decrease in grain size with increase in Bi concentration. The impedance study shows a non-Debye type relaxation. With increase in temperature the relaxation frequency shifts towards higher side. At various temperatures the frequency dependent AC conductivity indicates the thermally activated conduction process. Activation energies are determined by Arrhenius law and fitting of impedance and conductivity plots which results the decrease in activation energy with the substitution of Bi into BT ceramic.

Keywords: X-ray diffraction, SEM study, impedance, AC Conductivity.

Beneficiation study of Clays near Ramgarh – Naudiha area of Sonbhadra District, U.P., India

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Abstract- Clay is a major raw material used in making ceramic wares from ancient times. There are different kinds of clay having slightly different properties each of which is best suited for a particular purpose. The chief property of clay lies in the fact that when wet it can be easily molded into any desired shape, and then, when heated, part of the combined water is driven off, producing a hard, durable substance. [1] The clay that is mined from the earth is usually associated with various impurities like quartz, anatase, rutile, pyrite, siderite, feldspar, etc., depending on the origin and depositional environment.[2] These impurities impair the characteristics of clay and its utility for various end applications imparting off-white fired colour.

Clay deposits found in the Ramgarh – Naudiha area of Sonbhadra District, U.P. is a secondary clay type and is more siliceous with impurities, like iron-bearing, black-coloured materials, which limit the utility of the clay. The plasticity of the raw clay is low due to the higher silica content (67.33 – 87.67%) and Fe_2O_3 (0.10 – 2.02%) and poor in Al_2O_3 (8.10 – 19.81%). Its Loss on Ignition (LOI) value is also low (2.07 – 6.01%). The present study is aimed to assess the characteristics of the clay from the deposit and possibility of beneficiating it for various applications by adopting the known methods like size separation and magnetic separation. Basis of the beneficiation method is washing with water, followed by sedimentation. The clay particles remain in suspension in water for much longer periods during which the impurities like quartz, feldspar, iron minerals and mica, etc. settle down. [3, 4]

The beneficiated Clay showed that the SiO_2 (63.07 – 70.10%) and Fe_2O_3 (0.25 – 1.94%) contents were reduced while that Al_2O_3 (18.21 – 22.77%) and LOI value (5.77 – 7.29%) increased. The LOI value suggests presence of more kaolinite in the beneficiated clay. Wet sieving, therefore, removes almost all the quartz bearing impurities from the clay.

Although, beneficiated clay as such is not suitable for use as of high ceramic grade, however, it meets the properties like LOI, Al_2O_3 and Fe_2O_3 + TiO_2 content, shrinkage and firing characteristics for grade II and III ceramic raw material except the particle size distribution and water of plasticity as per IS:4589-2002. Further refinement in beneficiation techniques can improve in quality of clay for use as ceramic raw material.

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An AI-powered Novel Model to Ensure Occupational Health Safety

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Abstract- The COVID-19 Pandemic has left the globe in a state of uncertainty. With nations enforcing lockdowns to curb the spread of the disease, the world economy has gone into recession. There is a dire need for countries to reopen its economy and stimulate the manufacturing sector. With vaccine seemingly a distant vision, the only weapon to protect our workforce is the practice of social distancing and ensuring high standards of personal hygiene. Manually monitoring hundreds of workers in an industry is not feasible and hence, we need to look into Artificial Intelligence to carry out this herculean task. This work aims at ensuring occupational safety using various approaches. Firstly, all the workers entering the workplace need to stand in front of a camera, which records the attendance through facial recognition techniques. This would be accompanied by an Infrared sensor, which records the worker's body temperature and deems them to be fit or not to work. This approach would not only record the current body temperature, but also does a predictive analysis based on past trends. Secondly, the CCTV's powered with AI, screens the workplace to identify any breach of social distancing and lack of adherence to mask usage. This would intimate the worker through a dedicated app installed in his/her mobile phone. This would also be communicated to higher authorities over repeated breaches in a particular region. These may be narrow passages, due to which the workers are not able to maintain appropriate social distancing. This would augment the authorities' capabilities to enforce occupational safety measures. Another key feature is facilitating contact tracing. Whenever, a worker is diagnosed to be COVID-19 positive, others who have been in close proximity to him/her, could be easily identified and referred to medical care at the earliest. This could also help in risk classification of the workers depending upon the degree of the proximity and other preexisting co-morbid conditions, thereby prioritizing them for testing and isolation. On the whole, it's the responsibility of the employer to ensure highest degree of occupational safety to the workers. This would make the worker give his maximum output, thereby leading to increased productivity.

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Analytical Approach to the Optical Wave Propagation in Nonlinear Negative Refractive Materials

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Abstract- Now-a-days meta-materials [1] have been a subject of immense theoretical and practical interest due to their wide range of potential applications in the fields of sensing, trapping, and imaging. The most interesting aspect is that, these are artificially structured materials in the sub wavelength limit which can be designed at any required frequency regime. Negative refractive materials (NRMs) are the meta-materials where both the dielectric permittivity (ε) and the magnetic permeability (μ) are dispersive and negative in nature. They are artificially structured by stacking together arrays of thin wires and split ring resonator structures (SRRs) within a homogeneous dielectric. In most meta-materials, ε and μ show linear response which do not depend on the electromagnetic field intensities. However the nonlinear meta-materials are synthesized by embedding an array of thin wires and split ring resonators(SRRs) into a nonlinear dielectric, which can be used in several applications like switching the material properties from left to right handed and back, fiber optics, surface dynamics [2], intensity controlled transmission, photonic crystals and so on. In isotropic and homogeneous nonlinear meta-materials, the propagation of the ultra-short electromagnetic pulses is usually described by a system of coupled nonlinear Schrödinger's equation (NLSE) derived from the Maxwell's equations. For several years people have given significant efforts to obtain solutions of the higher order NLSE. There have been investigations of ultra-short pulse propagation in nonlinear NRM where a wide class of solutions for bright and dark solitons phase locked with the sources have been analyzed [3,4] for distinct parameter ranges.

In this article, the nonlinear pulse propagation has been analyzed by solving the NLSE in bulk media exhibiting frequency dependent dielectric permittivity (ε) and magnetic permeability (μ). The exact solutions obtained are shown to be of trigonometric type and localized in nature. The analytical and simulation based method has further been extended to investigate the intensity distribution inside a nonlinear NRM where the peaks of the intensity curve decreases with increase in frequency towards the magnetic plasma frequency. The stability of the solitonic solutions has also been established.

Keywords: Meta-materials, NRM, NLSE, SRRs, Solitons

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Electronic Structure of some Semiconductors using $\vec{k}\cdot\vec{\pi}$ Theory

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Abstract- We present the effective mass representation (EMR)[1] in the presence of spin-orbit interaction and an applied magnetic field. The resulting equation of motion in the $\vec{k}$ -space is then solved by using a Green's function formalism. The lack of lattice translational symmetry of the vector potential in the presence of the magnetic field is considered by redefining the Green's function in terms of the Peierls' phase factor. [2]The equation of motion of the Green's function as a function of a magnetic wave vector was solved using perturbation theory,[3] leading to expressions for the effective mass and the g-factor. We study the electronic structure of wurtzite Zinc Oxide [4]and Gallium Nitride[3]theoretically using the resulting $\vec{k}\cdot\vec{\pi}$ method, where $\vec{k}$ is the electronic wave vector and $\vec{\pi}$ is the relativistic momentum operator by considering the conduction band edge and three valence bands. The $\vec{k}\cdot\vec{\pi}$ Hamiltonians for the conduction band edge and the valence bands are diagonalized, considering the conduction band and one valence band at a time. We obtain electron and hole dispersions. Effects of other bands are considered by using perturbation theory. Resulting dispersions agree with the results of other calculations. In order to study the effective mass and the g-factor, we use the eigenvalues and Eigen functions obtained after the diagonalization. Our results for the effective masses and the g-factors agree fairly well with available theoretical and experimental results, Temperature dependence of both the electronic effective mass and g-factor in case of GaN is studied and trends obtained agree with the existing experimental data. Another interesting aspect is the study of many-body effects on the effective mass. We show that these are important for degenerate semiconductors like PbTe and SnTe.[5]

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$SrSn_{1-x}Fe_xO_{3-\delta}$(x=0-0.2) Perovskite Oxidesas Promising Functional Materials for Oxygen Sensor

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Abstract- Cubic phase (S.G.: P23) of iron substituted strontium stannate, $SrSn_{1-x}Fe_xO_{3-\delta}$ (x = 0, 0.05, 0.1, 0.15 and 0.2) were prepared by solid state reaction method. Linear decrease in lattice parameter with iron (Fe) substitution was observed using powder X-ray diffraction method. Electrical conductivity measured on bulk pellets of the above compositions using AC impedance spectroscopy shows that this functional material is a mixed ion & electron conductor (*MIEC*) and the conductivity increases with the Fe dopant concentration. The activation energy (E_a) deduced from their Arrhenius plots are in the range of 0.3 – 0.5 eV which implies that the mechanism of electrical conduction is same for all the compositions. X-ray photoelectron spectra show a divalent state for Sr, tetravalent state for Sn and a divalent state for oxygen irrespective of the composition leaving only Fe responsible for the increase in conductivity. Mössbauer spectroscopy studies reveal that Fe-ions in tetravalent, trivalent and divalent states with their relative proportion remain more or less same across the compositions. The increase in conductivity is mainly due to Fe^{3+} and/or Fe^{2+} ions because the isovalent Fe^{4+} substituted for Sn^{4+} do not contribute to changes in electrical conductivity as $SrSnO_3$ being an insulator with all Sn-ions in +4 valence state. Oxygen partial pressure dependence electrical conductivity studies of $SrSn_{1-x}Fe_xO_{3-\delta}$ (x = 0, 0.05, 0.1, 0.15 and 0.2) shows that $SrSn_{0.9}Fe_{0.1}O_{3-\delta}$ and $SrSn_{0.85}Fe_{0.15}O_{3-\delta}$ exhibit significant change in conductivity as function of oxygen partial pressure and have the potential to be tailored/engineered as percentage level oxygen sensors. Of these two compositions, $SrSn_{0.85}Fe_{0.15}O_{3-\delta}$ has less interference from moisture and therefore a more promising material.

Keywords: 1. Oxygen Sensor; 2. *MIEC; 3. Electrical conductivity; 4. p-type semiconductor; 5. Spectroscopy*

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Popularizing solar energy for a sustainable future and recent government initiative towards it

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Abstract- Renewable energy such as solar energy can create a clean environment and reliable energy source for future. It has huge applications and can be introduced in various sectors such as agriculture, creating medium and small scale industries, cheaper energy supply to remote areas etc. In agriculture, solar energy can be used to dry crops in solar dryers, creating green houses in cold and cloudy areas for better crop growth, using photovoltaic cells for lightening, electric fencing, running instruments associated with farming, supply fodder to domestic animals, for irrigation such as water pumping and moving sprinkler. The less expensive solar energy can make the farming more economical and efficient. We can empower remote tribal and hilly areas by installing solar power units. Mixture of nanometer-sized titanium dioxide(TiO_2) particles, coated with either cadmium sulfide(CdS) or cadmium selenide(CdSe) and suspended in a water-alcohol mixture to create a paint-like paste called solar paint when applied on the walls of building can generate small amount of electricity from solar energy . Transparent glass solar panels can be used as solar window, which can supply a sufficient amount of electric energy required in a building for everyday use. Making photovoltaic cells and solar energy related instruments can create a huge enterprise. This can generate new job opportunities and help in achieving target of "Atmanirbhar Bharat". Recent government has also started PRAYAS(Pradhan Mantri yogana for Augmenting Solar Manufacture) to create photovoltaic cell manufacturing as an export industry. Such other schemes related to solar energy include JNNSM(Jawaharlal Nehru National Solar Mission) which aims to deploy 20000MW grid by 2022, solar park scheme , providing subsidy to the person installing solar panales on roof top can motivate people towards the solar power utilization. In order to create a clean and green economy we can rely on solar power and its applications by enforcing popular government schemes.

Keywords: Renewable energy, photovoltaic cells, solar paint, solar window, atmanirbhar Bharat, PRAYAS, JNNSM

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Design and Development of Sustainable Glide Shoe

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Abstract- The past few decades have been declared as the best time period for human empowerment and inventions. Along with countless technological and scientific discoveries, mankind is flourishing with unimaginable power. All these are enough to make a person think "is this really happening?" But what's the catch? Newton's third law states that every action has an equaling and opposite reaction. Hence what are the opposite reaction to all these new discoveries and inventions? One simple word to explain would be environmental degradation. This single term contains thousands of problems to which man hasn't even found or thought of coming up with answers. When it comes to the industry of footwear, the materials and components used also play a major role in polluting the earth. For example, highly used materials like leather, PVC, PU, EVA, and TPR are extremely polluting and take a long time to degrade. Materials like this greatly affect the natural ecosystem which starts a chain of unfortunate events which eventually ends in irreversible damages to the environment. Another stressing problem is the waste management system of footwear materials. Disposal of these materials are extremely hard and requires a lot of money. Is this really the cost we can afford to pay? What can be done to undo these? Is there really a solution here? This is where this project GLIDE SHOES comes in. We are focused on manufacturing a shoe which is completely made of organic and easily degradable materials without diminishing the quality of it.

The human foot is one of the most important parts of the body and plays major roles in lots of functions. Truly understanding this means taking proper care of the foot and using products that are safe to use. But we are currently far away from this realization as we have no idea what harmful effects the components present in our shoes can cause to both our self and the environment. That is why creating a fully organic shoe that drastically decreases all the evil effects are required. Even though all the effects may not immediate, they still prevail. And not only does this help with saving the environment but also greatly reduces the cost of shoe preparation so it is available to every single person out there. Considering the fact that there are still thousands of kids out there who can't afford a shoe, this may provide an instant and easy solution. Right now the awareness for using biodegradable and renewable sources is getting stronger as humans understand what is happening to our home. It is high time that the same comes to the footwear industry too as is it a necessity. Not a privilege.

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Development of Sustainable Mineral Tanning Process

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Abstract- Leather was introduced many millennial ago. It is considered as one of the most demandable and luxurious goods, and we humans use leather in our day-to-day life. The process of making leather is a difficult task. Since 1833, we have been using chrome tanning which was invented by August Schultz. However, in the current scenario chrome tanning is the most popular tanning process implemented globally. And many other combinations process with chrome tanning has been discovered and achieved by the scientists/ researchers. Somehow, chrome tanning is harmful and hazardous to the nature, environment, animals and mainly to the tannery workers who are in constant contact with chrome salt. Chrome is a carcinogen product but it is still in use for production of leather. Will this continue forever? There is a solution for this cause; development of a new sustainable mineral tanning system in order to achieve wet blue. Pentahydrate Copper Sulphate $CuSO_4{\cdot}5H_2O$ is replacement of Basic Chromium Sulphate $Cr_2(SO_4)_3$. Being environmentally responsible, after inspecting all the aspects of the Basic Chromium Sulphate and Pentahydrate Copper Sulphate is preferable tanning agent in order to achieve wet-blue .Copper tanning is less hazardous and possesses high chemical properties which can improve physical properties of the leather rather than chrome tanning. This invention may change the quality of leather and also helps to resolve the environmental issues which are affected by chemical waste of the tannery. Both Chrome and Copper have exceptional cases of electronic configuration of transition metals. Chrome $3d^5\ 4s^1$ and Copper $3d^{10}\ 4s^1$ respectively.
Copper has higher values than chrome like, lightweight, higher shrinkage temperature for better smoothness of the leather, Copper in Pentahydrate Copper Sulphate can form octahedral geometry, possess high stability and it is more electronegative. Thus, it is highly soluble in water and makes stronger bonds (Electrovalent bond) and binds to protein. PCS- Pentahydrate Copper Sulphate ($CuSO_4{\cdot}5H_2O$) has higher shrinkage temperature which holds higher insulation properties; it can be beneficial for winter fashion collection (in the Garment Segment). The resultant waste of the tanning process, we can extract copper from the waste of the tanning waste and reuse it for other purposes. Considering all above facts, Pentahydrate Copper Sulphate should be referred as a new mineral tanning agent. This may be slightly expensive but still creates awareness and understanding related to the environment and sustainability in the manufacturing industry; and also encourages recycling or reuse of the chemicals or products.

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Sulfurization temperature driven grain growth mechanism of Cu_2ZnSnS_4 thin films prepared by ethanol based solutions

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Abstract- Cu_2ZnSnS_4 (CZTS) thin films, synthesized by dip coating solution process, offers a very promising absorber material for thin film solar cells because of its low cost, environmental harmless and earth abundant constituents. While hydrazine based solution processed films have yielded the highest efficiency of ~12.6%, the toxic and carcinogenic nature of hydrazine offsets the advantages. In the context of on-going worldwide research on solution based processing, size of grain has been found to be a crucial factor to fabricate efficient solar cells. In this work, we have prepared phase pure kesterite CZTS thin films of micro-sized large grains by dip coating process from ethanol-based precursor solution followed by sulfurization. The growth of grain size with sulfurization temperature has been studied. The increase in the grain size and uniformity with increase in temperature was observed. The results indicate the promise of the approach for facile growth of good quality films with large grains and hence high photosensitivity.

THIN-02

Structural properties of pre-annealed triple-cation mix-halide perovskites thin-films for solar cell application

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Abstract- Perovskite solar cells (PSCs) have shown a tremendous rise in efficiency from 3.8% to 25.2% because of their exceptional optoelectronic properties like large diffusion length, high absorption coefficient, tunable bandgap, and defect tolerance. The instability issue is the main obstacle in its commercialization. Among different perovskites, triple-cation mix-halide perovskites (TCMHPs) have shown improved stability and performance. The properties of perovskite thin-films like grain size, defects, and surface roughness, plays a vital role in the performance of PSCs. Here in this work, we fabricated thin films of TCMHPs to probe the effect of pre-annealing on the morphological and structural properties. With the help of XRD, we have shown the impact of pre-annealing on the crystal structure. FE-SEM and AFM are used to probe the effect on grain size and surface roughness. EDX and XPS are used to confirm the presence of elements. In this work, we found an enhancement in the structural properties of TCMHPs when coated on pre-annealed substrates.

Substrate Temperature Assisted Growth of Phase Pure Cu_2ZnSnS_4Thin Filmsby RF Magnetron Sputtering using a Single Elementary Target for Solar Cell Applications.

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Abstract- Cu_2ZnSnS_4 (CZTS) has been recognized as a very promising absorber materialfor inorganic thin films solar cell owing to its suitable optical and electrical properties. Further, its earth-abundant constituents offer potentialfabrication of low-cost solar cell. Among different deposition techniques, sputtering iswell recognizedas a suitable route for scalable production of thin films in opto-electronics technology. In this work, we report the growth of CZTS thin films by RF magnetron sputtering using a single elementary target. The films were deposited on soda-lime glass substrates (SLG) at different substrate temperature i.e., 300-500 ºC. The influence of substrate temperature on various properties of the deposited thin film has been studied using XRD, Raman, FESEM, EDS, UV-vis spectroscopyand IV characteristics. The XRD results reveal the evolution of a dominant kesterite phase of CZTS at 400 and 450 ºC which was further verified by Raman measurements. At a substrate temperature of 450 ºC, the CZTS film exhibited nearly idea stoichiometric compositions that contributed to their crystalline quality and grain growth. The electrical resistivity of the CZTS film grown at 450 ºC substrate temperature was 0.16 Ω-cm. The film showfavorable white light sensitivity, which is suitable for the solar cell applications.This study established the optimum substrate temperature required for the growth of kesterite phase without composition deviation in a single-step deposition process.

Enhanced Piezoelectric Performance of Flexible PVDF films for Hydroacoustic Applications

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Abstract- Piezoelectric materials have found great use in areas such as energy conversion [1], mechanical sensing and robotics[2]. Along with faster processing and low fabrication cost, the characteristics like flexibility and robustness of piezoelectric polymers[3] such as polyvinylidenedifluoride (PVDF) make them preferable than the piezo-ceramics like PZT. Moreover, the polarized PVDF films are known to exhibit a relatively high piezoelectric constant.To further enhance the piezoelectric property of these polymeric materials, we have fabricated PVDF films by a blown film extrusion method and then mechanically stretched by using a tensile machine to form a PVDF film having a predominantly β-phase crystal structure. When poled, these stretched films at an elevated temperature, under appropriate electric field give d_{33} values of ~>10pC/N. The blown films are analyzed using various techniques, viz. FTIR, XRD and DSC and their crystallinity and β-fraction content are calculated. The experimental results show that these PVDF films, when stretched along both transverse and machine direction, show enhanced piezoelectric coefficients after poling. This work reports the detailed fabrication process of PVDF blown films and their mechanical stretching for enhancing their piezoelectric properties.

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A new concept for windowless X-ray Detector based on CdSe-CdS core shell QDs

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Abstract- CdSe-CdS core shell QDs nano phosphor particles about 14.3nm were synthesized applying the hot-injection technique and deposited on the surface of the *conducting* fiber for detector application. The characteristic X-ray diffraction planes viz (100), (002), (101) and (102) of CdSe-CdS core shell QDs confirmed wurtzite structure. The quantum particle size was found out to be 12.4 nm using XRD and the value well matched with the TEM results. The V-I characteristics indicates that the sensing plates made up of fiber coated with CdSe-CdS core shell QDs material can be used for high-resolution sensing applications as compared to the virgin fiber..

Keywords: Conducting fiber, CdSe-CdS, Core shell QDs, TEM, SEM, XRD, photoluminescence

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Impact of p^+back surface field (BSF) layer thickness on the performance of Cu_2ZnSnS_4 thin film solar cells

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Abstract- Cu_2ZnSnS_4 (CZTS) has emerged as a very promising absorber material for use in inorganic thin film solar cells due to its high absorption coefficient ($\sim 10^4$ cm^{-1}) and direct tuneable band gap. While the properties of the CZTS thin films such as large grained uniform microstructure and phase purity are pre-requisites for high efficiency solar cells, it has been found that carrier recombinations at interfaces critically affect performance even for optimized CZTS thin film based devices.Among the two interfaces, favourable band alignment reduces the recombination at the p-CZTS/n-CdS interface. On the other hand, at the Mo/CZTS interface recombinations can be reduced by inserting a BSF layer. This BSF layer is a highly doped p-type layer which results in the formation of a p^+-p junction and creates a field at the back contact. This field will repel the electrons away from the back contact and will allow holes to move towards it. This will help to reduce electron-hole recombination at the back contact. Consequently, selection of an appropriate BSF layer becomes very important to enhance the performance of solar cell. In this work, we have evaluated the effect of a BSF layer on the performance of thin film solar cell having a structure in the form of Glass/Mo/BSF/CZTS/CdS/i-ZnO/Al-ZnO by using one-dimensional solar cell simulation programme SCAPS. In particular, the impact of thickness and acceptor density of the BSF layer (Cu_2O and SnS) has been elucidated. We show that an efficiency of about 15.70% for a CZTS based device using SnS BSF layer can be achieved against the current highest efficiency of 11.01%.

Electromagnetic Pulse Technology for Welding

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Abstract- Electromagnetic Pulse technology is a new and becoming popular day by day for its challenging technology. This technology enables joining and welding of not only dissimilar materials of with different melting temperature also it can join or weld of any geometry .This is also known as Electromagnetic Pulse welding (EMPW).It use pulsed electromagnetic field on electrically conductive work pieces. It is one of high-speed welding process which uses electromagnetic force from discharged current through working coil, which develops a repulsive force between the induced current flowing parallel and in opposite direction. Capacitive energy used as source in this technique and the job piece placed near actuator coil. This is a solid-state impact welding technique, where welding factors such as impact velocity, angle of impact, standoff distance, and thickness of flyer and overlap length must be chosen carefully. Energy dumping is an important factor in Electromagnetic. This is a prominent technique to join both similar and dissimilar metals with different melting points. EMPW performed by impact, with the application of Lorentz force. Parameters such as Voltage, Energy, Magnetic field and Magnetic Pressure are plays important role in this Process. EMPW has wide applications in nuclear industry, automotive industry, aerospace, electrical industries. However, formability and weldability still remain major issues.

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