St. Thomas college, Kozhencherry
Pathanamthitta District,Kerala, India. PIN: 689641
Email: stthomaskozhy@gmail.com
Phone: 04682214566
Fax: 0468-2215543

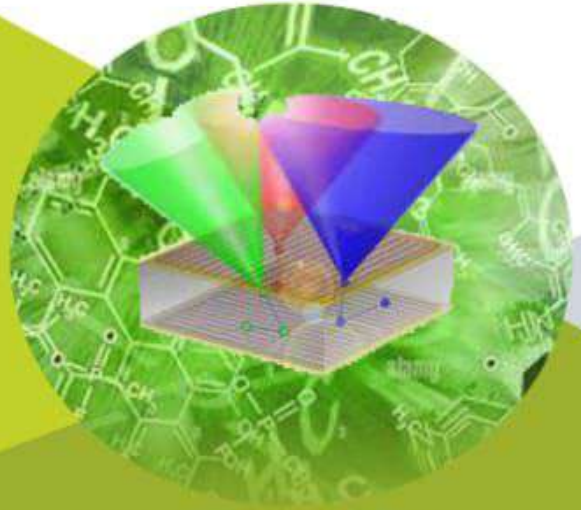
National Seminar

on

ADVANCED MATERIALS AND APPLIED PHYSICS

(NSAMAP-2023)
January 12-13, 2023

ABSTRACTS



PG & RESEARCH DEPARTMENT OF PHYSICS

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PG & Research Department Of Physics

Sponsored by

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NATIONAL SEMINAR

ON

ADVANCED MATERIALS AND APPLIED PHYSICS 2023 (NSAMAP 2023)

12th & 13th January 2023

Inauguration

Dr. Joy Vazhayil I.A.S.
(Hon'ble Chief Secretary, Govt. of Kerala)

Keynote address

Dr. Divya S. Iyer I.A.S.
District Collector, Pathanamthitta

LEAD INVITED SPEAKERS

Prof. Dr. Reji Philip
(Raman Research Institute, Bangalore)

Dr. Jinesh K.B
(Indian Institute of Space Science and Technology, Trivandrum)

Dr. Swapna S Nair
(Central University of Kerala, Kasaragod)

Dr. Marina Aloysius
(Assumption college, Changanacherry)

MAJOR THEMES

- Nanocomposites
- Nanophotonics
- Atmospheric Physics
- Environmental Physics
- Climate Change Studies
- Astronomy & Astrophysics
- Theoretical Physics
- Laser spectroscopy and non-linear optics
- Signal and image processing
- Metamaterials
- Multiferroics
- Ceramic Materials
- Nanofluids
- Numerical Modelling
- Crystal Growth
- Thin Films
- Nano Materials
- Magnetic Materials
- Biomaterials

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MESSAGE

I am very much delighted that the Postgraduate and Research Department of Physics, St. Thomas College, Kozhencherry is organizing a two-day National Seminar on Advanced Materials and Applied Physics 2023 (NSAMAP 2023), sponsored by Kerala State Council for Science, Technology and Environment (KSCSTE), Govt. of Kerala on 12th and 13th January 2023. In this era of technological strides, research in the field of Advanced Materials and Applied Physics has very important role. I notice with great satisfaction that the Department of Physics is making a commendable move in organizing this National Seminar to inculcate research culture among the students, teachers, and research scholars.

I appreciate and congratulate the Postgraduate and Research Department of Physics for their initiative and wishes for the success of this seminar.

Rt. Rev. Abraham Mar Paulos Episcopa

Manager

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MESSAGE

I am extremely happy that a two-day National Seminar on Advanced Materials and Applied Physics (NSAMAP-2023) is being organized under the aegis of the Department of Physics during 12th and 13th January 2023 in our campus. The field of Materials Science and Applied Physics is an ever-vibrant and exciting one that provides ample challenges for the desiring and deserving to make innovative and revolutionizing discoveries. I believe that the NSAMAP-2023 will provide a lively platform for a cross-section of society consisting of students, research scholars, and scientists to meet, explore and exchange ideas about different disciplines in the field of science. This National Seminar is a welcome activity, especially in the Platinum Jubilee year of our institution and it will go a long way in enhancing the Institute's interaction with the scientific community.

I extend my hearty congratulations and good wishes to the Department.

Dr. Roy George K

Principal

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FOREWORD

PG and Research Department of Physics, St. Thomas College, Kozhencherry, is highly privileged to have the opportunity of organizing a two-day National Seminar on Advanced Materials and Applied Physics (NSAMAP 2023) during 12-13 January 2023.

The objective of this National seminar (NSAMAP 2023) is to bring the students, researchers and scientists from across the nation on a common platform to share and access the recent trends in the field of Advanced Materials and Applied Physics and to discuss ways to promote promising societal applications. Today, social demands on science and technology are accelerating and growing more diverse and sophisticated. To cope with these demands, we are required to rapidly develop advanced materials through experiments or simulations, that will inspire the evolution of social and technological systems. NSAMAP 2023 is a key forum to present research to an interdisciplinary and national audience in which the scientific program will highlight the latest advances in materials research at an international/national level and also the basics of numerical modelling and simulation study using computational tools. This National seminar also provides important views on the critical issues of the environment such as flood and climate changes, drawing from many perspectives and disciplines. The thrust areas covered by the National Seminar are Nanocomposites, Nanophotonics, Atmospheric Physics, Astronomy & Astrophysics, Theoretical Physics and Signal processing. Over the course of two days, nationally-renowned speakers will describe how their research journey has developed in response to contemporary challenges: inspirational lessons in chemical initiatives and creativity. We are sure that this National seminar will provide young and talented students/research scholars a forum to show their talent by presenting their work besides avail exposure to the latest trends and developments.

We are extremely grateful to Kerala State Council for Science, Technology and Environment (KSCSTE), Government of Kerala for the financial assistance. We thank the Principal and Manager for their support and encouragement. While it is impossible to name all those who gave of their time, a special word of thanks must go to our student committee members, who worked long hours for the seminar.

We wish all our delegates a fruitful and pleasant time at St. Thomas College, Kozhencherry

Organizing Committee
NSAMAP- 2023

St.Thomas College, Kozhencherry

St.Thomas College, Kozhencherry was established in 1953, under the untiring visionary initiative of Very Rev. K.T. Thomas Kaseesa, ably supported by the then Metropolitan Dr. Juhanon Mar Thoma, the community in Kozhencherry, the parish here and of course Marthomites from different parts of Kerala. Set atop a hill, with an expansive view of the south western valleys, in a serene village, with the green panoramic Sahyadri in the east, close to the cool lush river Pamba, near the famous Maramon sandbank, beneath the green shades of Badam trees, the college provides a sublime and conducive natural ambiance for attaining academic eminence. The founding fathers envisaged the college as an instrument for enlightening, ennobling, and enriching the community by fostering academic excellence, moral integrity and social commitment in young men and women. The last 70 years have borne witness to the fulfilment of this dream by transforming the agrarian community into bustling centres of activity with all modern amenities and sophistication of the global economy. Curriculum, teaching learning process, research consultancy and extension, infrastructure and learning resources, student support and progression, governance, leadership and management and innovative practices in the institution have all been focused on the achievement of this vision.

PG &Research Department of Physics

Marching in unison with the college, the Physics department is also entering the 70th year of its inception. The Department of Physics of St. Thomas College is an internationally accredited Research Department of MG University offering PhD, PG and UG courses in Physics for the last four decades. The department offers research programs funded by DST, ISRO, IUSSTF and UGC in theoretical and Experimental Physics. The department has research labs for advanced materials, nanophotonics, computational Physics, Thin film research and Astronomy.

ORGANIZING COMMITTEE

Rt. Rev. Dr. Abraham Mar Paulose Episcopa (Manager)

Dr. Roy George K. **(Principal)**

Dr. Praveen S.S **(HOD i/c)**

Dr. Prathibha Vasudevan **(Convenor)**

Dr. Arthur Varghese

Dr. Jijoy P. Mathew **(Co-Convenor)**

Dr. Sheeba Anu Jacob

Dr. Soumya S.

Ms. Tiny Thomas

Programme Schedule

Day 1 12-01-2023 (Thursday)

Venue : Dr. Juhanon Marthoma Hall, St. Thomas College, Kozhencherry

9.00 am	**Registration**	
Inaugural session		
9.30 am	Invocation	
	Welcome address	Dr. Praveen S.S (HoD i/c, Physics Department)
	Presidential address	Dr. Roy George K (Principal) St Thomas College Kozhencherry
	Inaugural address	**Dr. Joy Vazhayil I.A.S. (Hon'ble Chief Secretary, Govt. of Kerala)**
	Keynote address	**Dr. Divya S. Iyer I.A.S. (District Collector, Pathanamthitta)**
Release of Abstracts Book		
	Felicitations	1) Mr. Abin Thomas Kaithavana (College, Treasurer) 2) Dr. George K. Alex (IQAC co-ordinator)
	Vote of Thanks	Dr. Prathibha Vasudevan (Convenor)
10.30 am		Tea break
Technical session I		
10.45 am to 12.00 pm	**Invited Talk – I**	Dr. Jinesh K.B (IIST, Trivandrum) *"Materials for Future Artificial Intelligence"*
12.05 pm to 01.00 pm		Paper presentations
01.00 pm to 01.45 pm		Lunch Break
Technical session II		
01.45 pm to 03.00 pm	**Invited Talk - II**	Prof. Dr. Reji Philip (RRI, Bangalore) *"Nonlinear Optical properties of novel materials: fundamentals and applications".*
03.00 pm to 04.30 pm		Paper presentations

Day II 13-01-2023 (Friday)

Venue : Dr. Juhanon Marthoma Hall, St.Thomas College, Kozhencherry

Technical session III		
9.30 am to 10.45 am	**Invited Talk - III**	Dr. Swapna S. Nair (Central University, Kasaragod) "*Engineered nanostructures for next generation nanoenergy harvesters and sensors*".
10.45 am to 11.00 am		Tea break
11.00 am to 01.00 pm		Paper presentations
01.00 pm to 01.45 pm		Lunch Break
Technical session IV		
01.45 pm to 03.00 pm	**Invited Talk - IV**	Dr. Marina Aloysius (Assumption College, Changanacherry) *"Climate change: Unravelling the Surprising Role of Aerosols".*
03.00 pm to 04.00 pm	**Valedictory session**	

CONTENTS

INVITED TALKS

ORAL PRESENTATIONS

IT- Invited Talk, OP- Oral Presentation

Nonlinear Optical properties of novel materials: fundamentals and applications

Reji Philip

Raman Research Institute

Bangalore 560080

Nonlinear optics (NLO) refers to the study of the interaction of strong light fields with matter. The advent of Nonlinear Optics was in 1875 with the discovery of the Kerr effect (quadratic electro-optic effect), followed by that of the Pockels effect in 1893 (linear electro-optic effect). In 1960, Franken and colleagues observed second harmonic generation (SHG) of ruby laser light in a quartz crystal [1]. Subsequently, Bloembergen and colleagues formulated a general theoretical framework for three- and four- wave mixing at optical frequencies [2]. Second order nonlinearities mostly involve optical frequency conversion while third order phenomena include nonlinear phase modulation, absorption, refraction and scattering of light.

In addition to facilitating a deeper understanding of light-matter interaction, NLO has also provided solutions for several practical problems. For instance, one of the major applications of NLO is the frequency conversion of laser light. Similarly, optical nonlinearity can be utilized for realizing many key-devices in the telecom industry such as switches, routers, and wavelength converters. Nanoparticles, nanocomposites and 2D materials have entered the realm of nonlinear optics in recent years because of phenomena such as quantum confinement of electrons and holes in semiconductor quantum dots, excitation of surface plasmon resonances (collective oscillation of free electrons) in metal nanoparticles, etc.

In this talk we will discuss the physical origins of optical nonlinearity in material media, and overview the nonlinear optical properties exhibited by some novel materials. Major experimental techniques for the determination of second and third order nonlinearities will be explained. Some interesting results obtained from the research work carried out in our lab also will be presented.

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Materials for future Artificial Intelligence

Jinesh K.B

Indian Institute of Space Science and Technology, Trivandrum

Our computational demand is exponentially increasing since last decade and we are reaching a computational need of processing 10 ZB per year since 2020. On the other hand, the transistor density in an IC is increasing as per Moore's law to cope up with the computations needs. However, the computational power seems to be saturated in the last decade due to the saturation of the clock-speed of the classical computers. This is an intrinsic problem arising from the original architecture of computers, called the von Neumann architecture. An exciting way to resolve this is to mimic how a biological brain works through parallel processing of information. This talk is about how physics would contribute to realising artificial neurons that can emulate brain functions through various materials and methods, for the emergence of the next-generation artificial intelligence.

Engineered nanostructures for next generation nanoenergy harvesters and sensors

Swapna S. Nair

Department of Physics, Central University of Kerala, Kasaragod- 671314, India

Harvesting energy from the surrounding vibrations and developing self-poared portable devices for wireless and mobile electronics are in great demand nowadays. Here authors demonstrate the synthesis of piezoelectric energy harvesters based on nanotube arrays by wet chemical route, which requires no coating instruments. The energy harvester gives an output voltage of 400 mV. Harvesting energy from a sinusoidal magnetic field is another interesting phenomenon.

Energy harvesting technologies have been attracting the attention of researchers over the last decade for their potential applications in low power-consumption electronic devices in the sub-micron scale[1,2]. Since the mechanical energy from all source of vibrations in the surroundings are abundant sources of renewable energy, research on harvesting these energies are making head way. Piezoelectric energy harvesters[3] can effectively convert mechanical vibrations into electrical energy, which make them promising in the areas of wireless sensors and low power electronics.

The ease of integration of material structures in to devices also makes these piezoelectric energy harvesters viable for integrated devices. 1-D nanostructures especially free standing vertical nanowires and nanotubes emerged as the major components for many of the nanoelectromechanical systems (NEMS)[4]. Advantage of integrating 1-D nanoarrays (nanowires and nanotubes) in energy harvesters is mainly due to its high electromechanical responses to feeble random disturbances in surroundings. Excellent electromechanical conversion capability of one dimensional piezoelectrics is first proved in the case of piezoelectric semiconductor nanowires of ZnO, where the power generation is due to the coupled piezoelectric and semiconducting properties[5–7]. Compared to ZnO, $K_{0.5}Na_{0.5}NbO_3$ (KNN) is found to

be one of the most promising candidates for the fabrication of piezoelectric energy harvesters, due to its fairly good piezoelectric properties (d_{33}~80-160 pC/N) and high Curie temperature (above 420ºC) [8–13]. Recently, KNN based energy harvesters have shown high electromechanical conversion efficiency comparable to PZT based devices[14,15].

Hence authors describe the synthesis and fabrication of piezoelectric and multiferroic cantilevers and evaluation of their potential for possible employment in sensors and energy harvesters. Owing to the hazardous effects of lead based compounds, lead free alkaline niobate based alternatives are sought after here. To fabricate their multiferroic counterparts, different possibilities like employment of different ferrites, magnetic alloys etc. as magnetic constituent is tried. The enhancement of magnetostriction and permeability is also tested. Magneto electric/multiferroic composites are synthesized in different geometrical configuration viz. 3-0 nanoparticulate composites, 2-0 composite films, 2-2 multilayers, and the development of a novel core shell nanotube based magneto electric system. The performances of these materials as sensor and energy harvester is tested and the results are elaborated here.

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Climate Change: Unravelling the Surprising Role of Aerosols

Marina Aloysius

Assumption College, Changanacherry

Climate Change refers to long term shifts in temperature and weather patterns. The world is presently experiencing severe the changes in climate. Heat waves, severe droughts, intense rainfalls, polar ice cap melting, sea level rise, intense forest fires are some consequences of climate change we are facing now. The effect the scientists have predicted due to climate change, long back is occurring currently in a faster pace than predicted. The earth is about 1.1° warmer than it was in 1800's and it is expected to increase by around 2.8° by the end of this century. The consequences of this increase are really complex and scaring. Urbanisation, industrialisation activities leading to extensive fossil fuel burning and land use changes are mainly responsible for the emission of green house gases in the environment. These green house gases blanket the earth, traps the heat and in turn increase the temperature and disrupts the balance of the nature. But over the past 40 years, however, much attention has been focused on the role of aerosols and aerosol-induced cloud changes as important contenders in the modification of the radiation balance of the Earth-atmosphere system and therefore in climate change scenarios. With this in view the session intends to give an introduction to the atmospherics aerosols, its properties emphasising and their interaction with incoming solar radiation and outgoing terrestrial radiation in various ways. The students will get a clear picture on how the aerosols participate in the cloud modification process and results in climate change and extreme weather events like heavy rainfall, drought, rising temperatures, cooling temperatures etc. The session intends to highlight the changing features of Indian monsoon and extreme weather events in India influenced by the action of atmospheric aerosols. The session will be useful in understanding the scope of research in the field of atmospheric aerosols related to its impacts on weather and climate and adaptation and mitigation policies required to combat climate change.

Running of spectral index for a hybrid inflationary potential

Rinsy Thomas[1,2,*] , Minu Joy[3]
[1]Department of Physics, CMS College (Autonomous), Kottayam, 686001, Kerala, India
[2]School of Pure and Applied Physics, Mahatma Gandhi University,
Kottayam, Kerala, India
[3]Department of Physics, Alphonsa College, Pala, Kottayam, 686574, Kerala, India
∗ Email: rinsy@cmscollege.ac.in

ABSTRACT

We describe a hybrid inflationary model with cubic potential, where inflation ends in a different way, due to a very rapid rolling of an auxiliary scalar field ψ. The slowly rolling inflation field φ does not account for the majority of the energy density in hybrid inflation. Another field ψ takes this role, which is held in place by its interaction with φ until φ falls below a critical value φc. When this occurs, ψ has been destabilized and inflation comes to an end by rolling towards its true vacuum. In this model the inflaton potential experiences a sudden small change in its second derivative (the effective mass of the inflaton). The spectral indices for perturbations created just before ($n1$) and soon after ($n2$) the phase transition are determined. Thus it is found that the ensuing density perturbation has a power spectrum that is nearly flat with a step in its spectral index.

Keywords: Cosmology; inflation; spectral index; scale dependence; high energy Physics

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Influence of Solar activity on the rainfall over Kerala, India

Elizabeth Thomas*, Punnya. S. Kumar and Noble P. Abraham†
Department of Physics, Mar Thoma College, Tiruvalla, Kerala, India. PIN 689 103
*Email: shinuelz@yahoo.co.in †Email: noblepa@gmail.com

ABSTRACT

In this work, we examine the possible relation of solar activity with the occurrences of rainfall events in Kerala, India. We use 57 years daily data (1965-2021), ie, Solar cycle 20 onwards, of solar activity indices (sunspot number, F10.7 index and Cosmic ray intensity) and gridded rainfall data over Kerala. The sunspot number is taken from **World Data Center SILSO, Royal Observatory of Belgium, Brussels, F10.7 index from** LASP Interactive Solar Irradiance Data Center, **Cosmic ray intensity from Oulu Cosmic Ray station and rainfall over Kerala from** IMD New High Spatial Resolution (0.25X0.25 degree) Daily Gridded Rainfall Data Set Over India (Pai et. al,2014[1]).

The rainfall and solar data are grouped into four seasons - winter (January-February as JF), pre-monsoon (March-May as MAM), monsoon (June- September as JJAS) and post monsoon (October-December as OND). The variation of different solar indices with rainfall are studied. In each of the solar cycles during the period of study, correlative studies are performed and correlation coefficients are computed for different seasons. We observe that the rainfall in Kerala is correlated with the sunspot activity, with varying significance. Sunspot number and F10.7 index showed more correlation with the rainfall data, compared to cosmic ray intensity. Solar cycle 21 revealed high correlation with significance, compared to other solar cycles. The winter season showed a better solar-rainfall link compared to other seasons. The excess and deficient rainfall years are calculated and compared with the solar indices. We notice that the excess and deficient rainfall years occur around solar maximum or solar minimum years during winter and monsoon seasons. We speculate a physical connection between solar activity and the rainfall events in Kerala.

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Numerical solution of K-dV equation in dusty plasma systemusing Fourier transform

Vineeth S[a], Manesh Michael[b] and Noble P. Abraham[a]
[a]Mar Thoma College Thiruvalla, Pathanamthitta, Kerala, India – 689103
[b]Barata Mata College Thrikkakara, Ernakulam, Kerala, India – 682021
Email: vineethsmaikkattu2@gmail.com

ABSTRACT

Dusty Plasma comprising of charged dust particles constitute all major as tronomical and many laboratory systems. We consider dusty plasma in a cometary environment comprising of positively and negatively charged dust ions, kappa distributed - solar electrons, cometary electrons and hydrogen ions. The existence of non linear waves such as solitons in these systems were explored in detail by various researchers analytically. In this article we solve the system numerically by deriving K-dV equation and solving it using Fourier transform. Hence we study the generation and existence of solitons. We also explore the characteristics of the solitons formed by simulation of the system for various initial conditions. The systemis found to have single soliton wave as exact solution and set of soliton wave train solutions for varied initial conditions. The soliton wave trains can be compressive, rarefactive or mixed in nature according to the initial condition. The simulation is helpful in understanding and modeling various dusty plasma systems.

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Image Enhancement using Deep Learning GAN

Robin Jacob Roy[a], b, Ligi Cherian[b], Ninan Sajeeth Philip[a]
[a] Artificial Intelligence Research and Intelligent Systems (airis4D), Thelliyoor, Kerala.
[b]Department of Physics, Christian College, Chengannur, Kerala.
Email: robinjacobroy1@gmail.com

ABSTRACT

In this paper, we present a machine learning tool called Generative Adversarial Network or simply GAN. GAN consists of two independent units. The objective of one unit is to generate fake data that looks similar to the data that is given for training the GAN. For example, assume that we have a collection of images of people. This unit will try to learn the features of all the people in the data so that it can synthesize similarly looking images - fake images. Now the job of the second unit is to learn how to differentiate fake images from real images. Both these units compete with each other, until, finally the second unit finds it impossible to distinguish a fake image from a real image of a person. This is how deep fake works where you can have movies made out of fictitious characters.

While the basic idea is the same, GANs algorithms come in a variety of flavors. Pix2Pix is such a variant that takes an input image and constructs an artificial image out of it. For example, the input image could be a satellite image of the city. Now we may also have a target image, and that might be a drawing of the map or plan of the city. In this case, the goal of the first unit in theGAN is to generate an artificial image that looks exactly like the drawing and the goal of the second unit is to figure out the errors in it! The training is repeated until the second unit is not able to distinguish the original map from the synthetic map. Once the training is completed, we only need the input image and the first unit to automatically generate maps from satellite images. In this paper, we demonstrate the applicability of the method to remove obscuring shadows from images. A Pix2Pix GAN is trained to remove shadows and exposure differences from photographic images and generates images with their noise profile removed. Visual qualities of the images could be greatly enhanced automatically by this method. Installing it in digital cameras would help in creating stunning photographs.

On the Period Determination of Eclipsing Binaries

Sindhu G[1], Ninan Sajeeth Philip[1,2]
[1]Department of Physics, St. Thomas College, Kozhencherry.
[2]Artificial Intelligence Research and Intelligent Systems, Thelliyoor.
Email: sindhug010@gmail.com

ABSTRACT

The study of variable stars has great importance in astronomy. For this study, we are selecting eclipsing binaries which are one major type of variable stars. Period changes of eclipsing binaries can be the evidence of the evolution of the stellar system. So finding the accurate period of eclipsing binaries is very crucial. In the present work, we are finding the period of Algol type, Beta Lyrae type and W Ursae Majoris type eclipsing binaries which are available in the Catalina Northern Periodic Variable Star Catalog using Lomb-Scargle algorithm. Phase-folded light curves were constructed for the verification of these periods. Our method produced results at par with CRTS catalog whereby independently confirming both results. We also checked our Lomb - Scargle model with other eclipsing binary catalogs and verified the results.

Numerical Modelling Of Flood Characteristics Along The Banks Of Chaliyar River Northern Kerala, India

Aswathy Vijayan[1] and Praveen S S[2]
[1]Doctoral student, Department of Physics, St. Thomas College Kozhencherry, Pathanamthitta, Kerala, India
[2]Assistant Professor in Physics, St. Thomas College Kozhencherry,Pathanamthitta, Kerala, India
Email: aswathyvysakh95@gmail.com

ABSTRACT

The state of Kerala located in the southernmost peninsular region of India, was in the shadow zone of several natural disasters. But the disasters like Tsunami, Ochki, Floods and Landslides exposed our vulnerability. Flooding is now a common phenomenon in Kerala because of its repeated arrival. Flood and its after effects are not predictable. The incalculable flood of 2018 caused property damages, economic loss and loss of human / animal life. Now our state is in the path of developing a Flood Warning System (FWS). The main component of a flood warning system is the prediction of run up and inundation along a bank which can only be accomplished through the process of numerical modelling. Several different global models are available for flood modelling and mapping. But many are laborious, time consuming and tedious. So alternate sources like open-source numerical models and satellite data sets are used for this investigation. HEC-RAS model developed by US Army corps of engineering was used in this study for estimating the run up and inundation along river banks of Chaliyar river in the Northern Kerala. The model was run in two modes - virgin and non-virgin modes. Besides rainfall was categorized in to four modes- normal rainfall (0.1-15.5 mm), moderate rainfall (15.6-64.4 mm), heavy rainfall (64.5-115.5 mm) and hypothetical rainfall (115.6-204 mm). The results for virgin simulation showed that for normal rainfall the run up is coming in the range of 0-0.25 m along the entire stretch starting from Chaliyam in the west to Ambalakkandy in the east. For moderate rainfall the run up is coming in the range of 0.25 – 0.75 m. For heavy rainfall and the hypothetical rainfall the run up is in the range of 0.75 – 1.25 m and 1.25-2.5m respectively. The normal and moderate rainfall showed no inundation along the locations starting from Chaliyam to Ambalakkandy. For heavy rainfall the inundation is coming in the range of 0-750 m. For hypothetical rainfall the inundation is coming in the range of 0.7 km – 1.5 km from Chaliyam to Ambalakkandy. The non-virgin model was done for 10% and 20 % of dam discharges and was coupled with moderate and heavy rainfall. The model predicted increased run up and inundation

along the entire stretch for both the cases. From the results of this simulation it can be concluded that normal and moderate mode of rainfall can't inundate the bank terrains of Chaliyar river, which can be attributed towards the elevation prevailing in that sector. However extreme rainfall events like that of the 2018 Kerala floods, similar to that of hypothetical simulation can inundate the terrain. The model predicted that inundation can increase when external discharges like dam discharges get coupled with normal rainfall discharges. This investigation recommends modelling using non linear models and fine resolution data sets for exactly predicting flood characteristics.

Assessment of the Impact of Urban Geometry On Urban Microclimate Using ENVI-MET Model

Nikitha Mary Monson* and George Thomas
Department of Physics, Catholicate College, Pathanamthitta - 689645, India
* Email: nikithamary1998@gmail.com Phone: +91 9400655067

ABSTRACT

More than half of the world's population lives in urban areas and are vulnerable to climate change. The enhancement of the urban heat island (UHI) is the major concern nowadays. The paradigm shift in the definition of UHI from the elevation in the temperature between urban and rural areas to the thermal differentiation between Local Climate Zones (LCZ) brings forth the potential to incorporate various modeling tools and simulations in urban microclimate studies. Although the microclimate models have been extensively studied in the context of modifying urban microclimate, they have less explored and validated in the humid tropical, monsoon-dominated climate. The aim of this study is to investigate the responsiveness of a three dimensional microclimate model, ENVI-met, to evaluate the impact of urban geometry on the urban thermal environment in the urban region of Kochi, a tropical coastal city on the southwest coast of India. Field measurements were carried out at two LCZ zones in the study area. Two sets of simulations were also carried out using the area input file attributes of the Compact Midrise Zone (CMR) and the Openset Midrise Zone (OMR) in LCZ classification. The results of the simulation reveal that the models adequately captured the diurnal variations of temperature in the CMR and OMR zones during simulation and observation. The findings of the simulation also emphasis that the urban geometry has a significant impact on the modification of UHI intensity.

Keywords: Urban microclimate; ENVI-met; Local Climate Zone; Urban Geometry

Estimation and Analysis of Atmospheric Parameters based on Satellite Derived Data Sets

Pavithra Sreekumar[1]& Praveen S.S[2]
[1]BSc. second year student, Department of Physics, St. Thomas College, Kozhenchery
[2]Assistant Professor, Department of Physics, St. Thomas College, Kozhenchery
Corresponding author: psreekumar857@gmail.com

ABSTRACT

Atmospheric Climatic Conditions are affected by various parameters such as atmospheric pressure, air temperature, visibility, dew point, UV Index, Air Quality Index (AQI), PM10, PM2.5, NO2, SO2, CO etc. The variation in these parameters determine the weather of a particular locality. These parameters form a chain reaction as their impacts don't remain solely in the atmosphere. For example, when the parameters like temperature, pressure and humidity interact to form clouds which can intern reduce solar radiation for plants or increase precipitation. Also, high temperature not only results in heating of air but can also contribute to the heat transfer to local bodies. Lack of precipitation affects weather. In addition to that, it affects soil moisture and water levels due to evaporation. Wind direction can indicate the movement of front into the sea. So, there is a need to observe and make detailed study about the atmospheric weather condition. Each parameter is measured by respective instruments. But instrumentation is not practical as it is time consuming and costly which make the study laborious and tedious. To solve that alternative methods like collecting data from remote sensing apps provided by agencies like ISRO can be effectively used. The study area is Venmony (Lattitude:9.239900 and latitude:76.628471) which is a village situated in Chengannur taluk of Alappuzha district of Central Travancore in Kerala, India. It is a region with mosques, churches and temples. So, there are many festivals per year in which large amounts of crackers are used. Also, vehicular emissions in this region are high. Different mobile applications provided by Government and other private agencies are used for this investigation. There are 12 parameters such as temperature, pressure, humidity, visibility, dew point, UV Index, Air Quality Index (AQI), PM10, PM2.5, NO2, SO2, CO etc. and monthly variation of each parameter is collected and plotted separately for analysis.

The methodology included collection of monthly data, its seasonal classification, estimation of average values, trend of different parameters and Variation of different parameters. Besides its fluctuations with reference to standard values were also

carried out. As a comparative study two more weather reporting apps (Accurate Weather Forecast and Weather-Live & Forecast) were used for data collection for a specific period of time. The results indicated that there are fluctuations in the atmospheric parameters based on seasonal changes. Apart from that the investigation also showcased various fluctuations happening in atmospheric parameters due to different man made activities. The comparative investigation unraveled that there are minor variations in estimated atmospheric parameters which can be attributed towards the resolution features of applications.

Estimation of Field measured Topographic Data and Its comparison with Satellite Data Sets

[1]Malavika Anil, [2]Prithush D Nair, [3]Aswathy Vijayan & [4]Praveen S S
[1,2]BSc Student,St.Thomas College, kozhencherry, Pathanamthitta, Kerala, India
[3]Doctoral Student, St.Thomas College Kozhencherry, Pathanamthitta, Kerala, India
[4]Faculty in Physics, St.Thomas College Kozhencherry, Pathanamthitta,Kerala , India
Email-malavikaanikurup@gmail.com

ABSTRACT

After 2017 Kerala has become vulnerable to several natural disasters. Though there were coastal erosions and various other sea attacks in Kerala, those were not at all severely threatening to property and life. But the Tsunami of 2004, Ochki of 2017, landslides and landslips, floods of 2018,2019 and 2020 devastated many parts of Kerala. Though there are several components which determines devastation vulnerability, the topographic elevation places a pivotal role in shaping attacking vulnerability along a terrain. Measurements of elevation can be done using several different field measuring instruments. Those instruments are costlier and so it can't be affordable to independent student researchers. So alternate sources of topographic data collections can be done using satellite data sources. The extraction of satellite data and its analysis using different tools are also expensive. At this juncture this paper is an attempt to map the elevation in and around the premises of St. Thomas College,Kozhencherry. The mapping was done on the basis of different mobile applications for elevation measurements, The mobile applications are My Altitude and Elevation -GPS, GPS Location and Elevation, Accurate Altimeter and My GPS Coordinates. To validate the data sets, satellite data sets were also downloaded and compared. The four mobile applications showed a varying pattern of elevations both in increment mode and decrement mode. The three satellite data sets also showed a varying pattern. The next step of the work is to correlate and correct it by fine tuning it with a correction factor which is being proposed as a future work in this direction.

Structural and optical properties of low energy N+ ion implanted PbS thin films

Jeya P.[1,2], L.Kungumadevi[2] , and Asokan Kandasami[3,4]
[1]Department of Physics, CMS College, MG University, Kottayam, Kerala, India
[2]Department of Physics, Mother Teresa Women's University, Kodaikanal, India
[3]Inter University Accelerator Centre, NewDelhi, India,
[4]Department of Physics & Centre for Interdisciplinary Research, University of Petroleum and Energy Studies (UPES), Dehradun, India

ABSTRACT

We report the experimental results on the effect of N ion implantation on lead sulphide (PbS). PbS nanocrystallites were first synthesised by a cost-effective chemical method and then deposited on a glass substrate by the thermal evaporation method. The as-prepared thin film of thickness 500nm was implanted with 20keV N ions with the ion fluence of $5x10^{15}$ ions/cm^2. The impact of N^+ ions on the structural and optical properties of PbS was investigated by analysing X-ray diffraction (XRD), EDAX, UV-Visible, and photoluminescence spectroscopy. The average crystallite size of PbS was calculated from XRD using Debye-Scherrer's formula and it is found to decrease from 12 nm (pristine) to 9nm for ion fluence of $5x10^{15}$ ions cm^{-2}. From the optical studies it is found that the bandgap energy increase to 1.9eV(from 1.71eV) with ion fluence. All these results confirm the modification of stuctural and optical properties of PbS with the low energy N ion implantation.

Keywords: PbS thin film, ion fluence, Optical studies.

Lactose monohydrate assisted reduction and spectral analysis of cubic CuFe2O4

Vibhu T. Sivanandan[1] and Arun S. Prasad[2*]
[1]Research and Post Graduate Department of Physics (affiliated Research Centre of University of Kerala), Sree Narayana College, Kollam, Kerala-691001, India
[2]Post Graduate Department of Physics, T. K. Madhava Memorial College, Nangiarkulangara, Alappuzha, Kerala-690513, India
*Corresponding author, e-mail: asp.physics@gmail.com

ABSTRACT

Spinels represent the mixed metal oxides having the general structure AB_2O_4; in which A and B are divalent and trivalent cations respectively [1]. Among the various nanospinels, copper ferrite ($CuFe_2O_4$) is one of the widely used material for modern electrical and bio medical applications. $CuFe_2O_4$ can be crystallized either in a tetragonally distorted spinel structure (T-phase) with c/a ratio greater than 1 or cubic spinel structure (C-phase) [2]. In general, copper ferrites have an inverse spinel structure under the space group fd3m [1]. In the present report nanocrystalline C–phase copper ferrite was synthesized by phytochemical reductant Lactose monohydrate (C 12 H 22 O 11 .H 2 O) mediated coprecipitation method. The crystallographic information such as, lattice parameter, size, microstrain, density, inversion parameter and mechanism of formation of the sample were elucidated via X-ray diffraction (XRD) analysis. The FTIR measurement is used to estimate the homogeneity and hydrophilic behaviour of the prepared sample. The crystallite size of the sample is found to be 17 nm. The semiconducting behaviour with a direct band gap of 3.21 eV for the sample was obtained from the UV-Visible reflectance data using Tauc's plot employing the Kubelka Munk function [3].

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BiOCl: Dy^{3+} / Ba^{2+} nanophosphors: Synthesis, luminescence characteristics and applications in latent fingerprint detection and cheiloscopy

Ansu Sara Solomon, Prathibha Vasudevan*
PG and Research Department of Physics, St. Thomas College, Kozhencherry, Pathanamthitta, Kerala, 689641, India.
*Corresponding author. E-mail: prathibhavspap@gmail.com

ABSTRACT

Here, we systematically investigate the structural and luminescent behaviour of Ba^{2+} co-doped BiOCl:Dy^{3+} nanophosphors synthesized by a cost-effective solid-state reaction method. The effect of Barium concentration on the structural and optical properties of Dy^{3+} doped BiOCl phosphors was examined in detail. The X-ray diffraction (XRD) patterns and Rietveld refinement revealed that the as-prepared phosphors had a tetragonal crystal structure with the space group P4/nmm. X-ray Photon spectroscopy (XPS), Fourier Transform Infrared Spectroscopy (FTIR), and Raman analysis unveiled the elemental composition and vibrational modes of the prepared sample and it directly confirms the incorporation of Dy^{3+} and Ba^{2+} ions into the BiOCl lattice. The enhancement in the luminescence intensity is observed in the photoluminescence spectra due to the lattice distortions around Dy^{3+} ions. The decay time obtained in microseconds implied the fast-switching response of the nanophosphors. The prepared nanophosphors at optimum concentration was used for development and visualization of latent fingerprints (LFPs) and Cheiloscopy for individual identification in forensic science. Our results reveal that the synthesized nanophosphors has potential applications in the field of color displays and may act as a valuable tool for law enforcement.

Keywords: Phosphors, Luminescence, XRD, XPS, fingerprint

Structural, Optical and XPS studies on LaFeO3 perovskites synthesized through solution combustion technique

Pranav P[a] and Arun S. Prasad[*b]
[a]Research and Post Graduate Department of Physics (affiliated Research Centre of University of Kerala), Sree Narayana College, Kollam, Kerala-691 001, India
[b]Post Graduate Department of Physics, T. K. Madhava Memorial College, Nangiarkulangara, Alappuzha, Kerala-690 513, India
*Corresponding author, email: asp.physics@gmail.com, drarunsprasad@tkmmc.ac.in

ABSTRACT

For a variety of applications involving optoelectronic and photonic devices, perovskite materials have emerged as the most promising and efficient low-cost energy materials. The perovskite materials can be described using the general chemical formula ABX_3, where A and B are cations, with A larger than that of B and X is the anion, which is typically composed of oxides or halogens. In this study, Ascorbic acid has been used which is a water-soluble vitamin naturally available in citrus and other fruits. Spectral techniques such as XRD, FTIR, DRS UV-Visible, XPS were used to describe the material. The XRD pattern for $LaFeO_3$ shows that it has an orthorhombic primitive lattice in the Pn*(62) space group, and that its average crystallite size is 26 nm. Vibration bands associated with functional groups and metallic sites in the samples were studied using Fourier transform infrared spectroscopy. Stretching vibration of Fe-O causes a stronger peak at 536.4 cm^{-1}. Using the Kubelka-Munk function, we can calculate that the optical band gap is 4.51 eV based on Tauc's plot. Deconvoluted XPS spectra were used to correctly identify the valence states of La and Fe in the prepared LaFeO3 perovskite oxide sample.

Keywords: Perovskites, solution combustion, phytochemical, Kubelka-Munk function, Tauc' plot, XPS

Multiferroic polymer nanocomposite for Electromagnetic shielding

Rishi M, Anju Rajan , Raneesh B , Karthika S
Research and PG Department of Physics, Catholicate college Pathanamthitta
Email: karthumedayil@gmail.com

ABSTRACT

In the modern days, electromagnetic shielding (EMI) receives more attention from researchers because of the exponential increase in the use of wireless equipment's. so, the development and use of effective EMI shielding materials play a crucial role to minimize the adverse effects of electromagnetic radiations and interferences. The current trend in EMI shielding material is focused on polymer nanocomposites, particularly in conductive polymers. Due to their distinct qualities including lightweight, processability, environmental stability, durability, and less corrosive with tunability, conducting polymer-based composites have received particular attention. Materials that fall in multiferroics category show more than one of the primary ferroic properties in the same phase. The multi-ferroic polymer nanocomposite material is considered as excellent EMI material and the shielding efficiency can be explained in terms of reflection loss, absorption loss and multiple Reflection.

Electrical Conductivity Studies and Barrier Hopping Transport in Europium doped Graphene Oxide Nanocomposites

Aswini Mariam Vinod, Anju Elizabeth Yohannan, Meenakshy Salim, Asiya Shafeek, Dhanya I*
Department of Physics, Catholicate college, Pathanamthitta, 686645, Kerala, India
Email: dhanya.iv@gmail.com

ABSTRACT

Graphene oxide is prepared by Modified Hammers method and is doped with varying concentrations of Europium ions. Surface morphology and structure of the samples are analysed by AFM and XRD respectively. Optical absorption studies for all the samples show that Europium doped and undoped graphene oxide samples possess ultra-wide band gap energy. DC electrical conductivity under two probe methods is adopted to get activation enthalpy. Analysis of Variable Range Hopping is carried out to understand the transport mechanism of charge carriers through the doped and undoped graphene oxide layers. Low temperature ac conductivity in the samples proposes the best suit of bi-polaron transport mechanism in samples with the correlated barrier hopping model. Europium doped Graphene Oxide composites are found to be characterized with small extrinsic activation energy and hopping distance for getting better conductivity apart from pure graphene oxide samples.

Nano Silver doped Graphene Oxide composite for Super Capacitor application

Anju Elizabeth Yohannan, Aswini Mariam Vinod, Meenakshy Salim, Asiya Shafeek, Dhanya I*
Department of Physics, Catholicate college, Pathanamthitta, 686645, Kerala, India
Email: dhanya.iv@gmail.com

ABSTRACT

Graphene oxide (GO) is prepared from graphite powder using Modified Hummer's Method. Silver nano particles are prepared by chemical method and add nano silver to GO in varying concentration to study the effect in detail. SEM analysis is performed to get the surface morphology of the samples. Stochiometric ratio and chemical composition in the samples could analyze by means of Energy Dispersive Spectral analysis (EDX). Structural studies are performed by X-ray diffraction studies (XRD). Unique hexagonal carbon structure is followed both in GO and silver doped Graphene oxide. From UV-visible spectroscopic analysis, it is observed that the absorption band for sample with highest concentration of nano silver possessa controllable grain size at nano regime. The band gap energy for doped samples is wider than Graphene oxide and it undergo a direct allowed type band transition between the bands.

Graphene and its oxide are known for super capacitance behavior. For analyzing the capacitance of graphene oxide with nano silver doped Graphene oxide, cyclic voltametric studies are carried out and specific capacitance is calculated.

Hierarchical Nanostructures for Supercapacitor Electrodes

Anandhu T. P [a], Rohith R [a], Jayesh Cherusseri [b], Ranjini R. Mohan[c], Sreekanth J. Varma [d*]
[a] Materials for Energy Storage and Optoelectronic Devices Group, Department of Physics, Sanatana Dharma College, University of Kerala, Alappuzha, Kerala-688003, India
[b] Graphene & Advanced 2D Materials Research Group (GAMRG), School of Engineering and Technology, Sunway University, No. 5, Jalan University, Bandar Sunway, 47500 Subang Jaya, Selangor, Malaysia
[c] Advanced Fiber Energy Devices Laboratory, Research & Development Division, JC Puli Energy Private Limited, Koduvayur, Palakkad, Kerala-678501, India
[d] Division for Research in Advanced Materials, Department of Physics, Cochin University of Science and Technology, Kochi, Kerala-688022, India
*Corresponding author: sjv@sdcollege.in

ABSTRACT

Supercapacitors are now an essential part of portable electronics and electric vehicles among different energy storage systems. Transition metal sulphides with a high pseudocapacitive nature stand out among the available materials as potential supercapacitor electrode materials. However, the poor electrochemical cycling stability of transition metal sulphides prevents their use in real-world applications. These stability problems can be effectively resolved by forming hierarchical hybrid nanostructures using transition metal oxides having excellent electrochemical behaviour. Here, we describe a two-step hydrothermal synthesis of nanocrystalline Ni_3S_2/MnO_2 hybrids for use as supercapacitor electrodes. The incorporation of MnO_2 increases the electrode surface area and the ensuing synergistic effect aids the Ni_3S_2/MnO_2 nanostructured hybrid in achieving the best electrochemical performance and stability. The Ni_3S_2/MnO_2 hierarchical hybrid nanostructured electrode exhibits an areal capacitance of 2892 mF cm^{-2} at a current density of 1 A g^{-1} in 1 M KOH aqueous electrolyte. Along with the enhanced pseudocapacitance, the hybrid electrode exhibits a cycling stability of 96.8% even after 25000 charge/discharge cycles performed at a current density of 5 A g^{-1}.

Studies on Perovskite based Ferroelectric Nanomaterials

Karthik Vinodan, B. Raneesh
Department of Physics, Catholicate College, Pathanamthitta, Kerala-689 645, India
Email: vinodankarthik@gmail.com

ABSTRACT

Perovskite oxides with ferroelectric properties are one of the most promising nanomaterials used in electronics. The nanostructured perovskite material shows the excellent ferroelectric property at room temperature. The perovskite oxides ABO_3 have corner shaped framework of BO_6 octahedral with A site cation enclosing. A significant class of perovskite oxides possess ferroelectric properties with reversible polarization on applying an external electric field and are important in various energy storage and memory device applications. In this work, the ferroelectric properties of perovskite sodium niobate ($NaNbO_3$) nanoparticles are studied. The modified sol-gel method is used for nanoparticles synthesis. The structural studies were done using X-ray diffraction techniques and Fourier Transform Infrared Spectroscopy. Transmission electron microscopy was used to study the morphology of synthesized nanoparticles. The polarization versus electric field (P-E) hysteresis loops were traced at different temperatures. Through proper temperature tuning, the perovskite material can be used for various energy storage and temperature sensor applications.

Fabrication of PVDF-HFP based Magnetoelectric fibers: A potential candidate for advanced magnetoelectric applications

Sobi K Chacko, Raneesh. B
Department of Physics, Catholicate College, Pathanamthitta, Kerala-689 645, India
Email: sobikchacko@gmail.com

ABSTRACT

Magnetoelectrics (ME) are the materials in which magnetic and electric orderings co-exist. Flexible ME nanocomposite fiber mats were fabricated based on an electroactive polymer, poly (vinylidene fluoride co-hexafluoropropylene) (PVDF-HFP) loaded with nanoclay and ferrite nanoparticles. Different weight percentages of ferrite nanoparticles were loaded in the polymer-clay systems and their morphological, dielectric, magnetic and magnetoelectric properties have been studied. X-ray diffraction (XRD) and Fourier transform infrared spectroscopy (FTIR) were used to validate the enhancement in the ferroelectric β phase of PVDF-HFP. Electrospun nanocomposite system with 8 wt% ferrite nanoparticles exhibited the highest value of magnetoelectric coupling coefficient (MECC) and dielectric constant (≈17mV/cm.Oe and ≈29 respectively). High flexibility along with room temperature multiferroic properties make PVDF-HFP/Clay/ferrite polymer nanocomposite fibers a suitable candidate for device applications.

Synthesis Of Silver Nanoparticles from Plant Extract – Mint, Tulsi and Brahmi: A Review

Hariprasad M. S[a], Lakshmi Prasad[b], Sheeba Anu Jacob [c]
[a] School of Chemical Engineering and Physical Sciences, Lovely Professional University, Jalandhar, Phagwara, Punjab
[b]Amity Institute of Applied Sciences at Amity University, Uttar Pradesh, Noida Campus
[c]PG and Research Department of Physics St. Thomas College, Kozhencherry.
Email: hariprasadms2000@gmail.com

ABSTRACT

This review is based on the synthesis of silver nanoparticle synthesis with particular emphasis on biological synthesis using plant extracts of Mint, Tulsi and Brahmi. Review on synthesis from these plant species are done as they are highly beneficial on medical field and are commonly found in Indian Subcontinent. Synthesis mechanisms and overview on present and future applications of silver nanoparticles synthesised from Mint, Tulsi and Brahmi are discussed in this review. Comparison between silver nanoparticles obtained from these species is done with the help of various analysis results. Comparative study between green synthesis and chemical synthesis of silver nanoparticles (AgNPs) are also summed up in the present review. Applications and limitations associated with the use of silver nanoparticles are also summarized in this review.

Multifunctional Piezoelectric Polymer Nanocomposite for Energy Harvesting applications

Anju Rajan [1*], B Raneesh[1], Karthika S[1]
Department of Physics, Catholicate college, Pathanamthitta, Kerala-689645, India.
Email: anjuratheesh1110@gmail.com

ABSTRACT

Due to the increased energy requirements of daily life and concerns about global warming, extensive research is being carried out to establish self-powered electronic devices. Since the last few decades, portable smart electronic devices with expanded durability have become the first choice for every human being. These devices use power from different sources such as solar, wind, nuclear power, thermal energy, and mechanical vibration. Among different energy harvesters, mechanical vibration-based harvesters have been manifested to provide greater potential, a better lifespan, and a comparatively high-power density. Several methods are available for the transformation of mechanical vibrations into electrical energy, viz., the electromagnetic, electrostatic, and piezoelectric effects. Because of their simple configuration, maximum conversion proficiency, and capacity to be integrated into more complex systems, piezoelectric energy harvesting systems have attracted increased attention. Irrespective of the better piezoelectric properties associated with piezoelectric ceramics, some of their disadvantages, such as rigidity, brittleness, toxicity, a lower voltage coefficient, and a lack of design flexibility, limit their energy-related applications to some extent. Polymeric piezoelectric composites for energy harvesting applications are considered a significant research field because they provide the convenience of mechanical flexibility, suitable voltage with sufficient power output, lower manufacturing cost, and rapid processing compared to ceramic-based composites. Polymer piezoelectric systems can be fabricated in bulk, composite, layered, or film form, depending on the application and conditions. Incorporation of inorganic and organic nanofillers improves the piezo-responsiveness of the piezoelectric polymers.

Algal Fuel Cell

Johyna Els Thomas, Soosen Samuel M*
PG and Research Department of Physics, Catholicate College, Pathanamthitta
Email: soosenbinoy@gmail.com

ABSTRACT

An Algal fuel cell is a biological fuel cell that converts chemical energy to electrical energy by capturing of electrons by the process of photosynthesis. Algae can be used either in anode / cathode chamber. During the light reaction in photosynthesis, photolysis of water takes place in the chloroplast as a result electrons are produced along with protons. This electron is used for the production of electricity. Algae was preferred over other plants due to its speedy growth, less surface area for thriving, very high photon conversion efficiency compared to other terrestrial plants and due to their abundance in nature. Compared to other green energy resources algae have a stable and controlled production of energy. In this study three types of plant microbial fuel cells (PMFCs) were constructed. In the first PMFC zinc was used as the anode and carbon as the cathode. The second PMFC used copper as the anode and carbon as the cathode. The third PMFC made us of zinc as the anode and copper as the cathode. Of all three PMCs, the first combination of electrode presented the most efficient cell. The high electropositivity of the zinc anode helped produce a current of 2.25mA. The average power density was calculated by measuring the voltage readings across the external circuit of the PMFC at different times from early morning to midnight at an interval of 3 hours constantly from the 7th day of inoculation to the 12th day. The rate of production of electricity was observed to be different for various algae. Factors such as sunlight distribution, population density of the algal cells, nanomodified anodes played a vital role in the power distribution.

Structural and Antibacterial effect of Zirconia nanoparticles

Anagha P[1], Kallu Vijayan[1], Vineetha V [1], Devika S [1] and Karthika S*
[1]Former Post Graduation student, Department of Physics, Catholicate College, Pathanamthitta, Kerala, India
*Assistant Professor in Physics, Catholicate College, Pathanamthitta, Kerala, India
Email:anaghadask7@gmail.com

ABSTRACT

Pure zirconia has three different crystal structures: monoclinic, tetragonal and cubic. Pure zirconia can exist in one of three states depending on the temperature. Zirconia is characterized by high flexural strength and fracture toughness as a result of a physical property known as transformation toughening.It acts as catalyst for synthesis and transformation reactions. The earlier studies conducted proved its biocompatibility. Several positive characteristics of zirconia, such as biocompatibility, color and mechanical properties, make the material suitable for use in modern dentistry. Zirconia nanoparticles were successfully synthesized by sol-gel method which required less processing time. The crystalline nature and the phase purity of the prepared sample have been analyzed by XRD spectrum. The bending and stretching vibrations of zirconium oxide samples were analyzed through FTIR. The size of the synthesized ZrO2 nanoparticles were measured using TEM.

For the study of antibacterial effect of Zirconia nanoparticles, various combinations of Zirconia nanoparticles were synthesized by cost effective sol gelapproach. Various combinations prepared are: Zirconia with lemon, Zirconia withturmeric, Zirconia with silver and Zirconia with Titanium. The antibacterial potential of various combinations of Zirconia nanoparticles was determined by the agar disc diffusion method against Staphylococcus aureus and Klebsiella pneumoniae. The most significant zone of inhibition was observed in the Zirconia with silver combination. The results illustrated that Zirconia with silver particles had potential inhibitory activity against Staphylococcus aureus and Klebsiella pneumoniae. Thus, the synthesized Zirconia with silver particles will be a valid candidate in the health care system due to its multifunctional applicability.

Effect of doping on the structural properties of Barium Titanate nanoparticles

[1]Dhanya Raj, [2]Manjusha M.V
[1]Research Scholar, The Cochin College, Kochi, Ernakulam, Kerala, India
[2]Assistant Professor, The Cochin College, Kochi, Ernakulam, Kerala, India
Email: dhanyaraj1282021@thecochincollege.edu.in

ABSTRACT

Nanotechnology deals with particles in the size range of matters having dimensions of the order of $1x10^{-9}$m. Nanotechnology broadly refers to the field of applied science and technology that studies nanoparticles and understands and monitors m 1 to 100 nanometers. Nanotechnology covers a broad range of material manufacturing process and technologies associated with the improvisation and enhancement of nanomaterial to apply in industrial and everyday life. Nanoparticles are generally found in clusters and possess structures similar to the bulk of the material, but the properties change drastically when reduced to nanoscale. Geometrical, electrical, optical as well as the biological properties changes drastically. They exhibit much better and improvised physical, chemical and biological properties. Barium titanate ($BaTiO_3$) is a class of multifunctional ceramic materials with unique properties such as thermal stability, excellent piezoelectric constant, excellent dielectric constant, environmental friendliness, and excellent photocatalytic activity. These properties make barium titanate indispensable in many application areas such as electromechanical devices, thermistors, multilayer capacitors and electro-optical devices. The photocatalytic activity of the barium titanate semiconductor is hampered by its large bandgap and high charge recombination rate. The high responsibility of BaTiO3 coupled with its piezoelectric and thermoelectric properties may be a solution for providing multifunctional nanodevices in the fields of sensing, energy harvesting and thermal control.

This paper describes the synthesis and characterization of barium titanate ($BaTiO_3$) nanoparticles and iron (Fe)-doped barium titanate (FeBaTiO3). Barium titanate nanoparticles are produced by the sol-gel method. Fe-doped BaTiO3 nanoparticles with doping rate of 1%, 2% and 3% were also fabricated using the sol-gel method. Find the particle size, hkl plane, lattice strain, and lattice constant from the observed XRD peaks. From UV-Vis spectroscopy studies, the band gaps of the samples were calculated by plotting tauc plots.