

**2021-2023**

**Investigation of the structural properties of reduced graphene oxide (RGO)**

**via green hydrothermal method at different temperatures**

A project report submitted to the University of Kerala for the partial fulfilment of the

Requirement for the degree of

**MASTER OF SCIENCE**

**IN PHYSICS**

By

**ARDRA SAJEEV**

**Reg. no: 63021128002**



**Sree Narayana College,**

**Chengannur**

**Under the supervision of**

**Dr. VINOY THOMAS**

**ASSOCIATE PROFESSOR AND**

**HEAD OF THE DEPARTMENT**

**CHRISTIAN COLLEGE**

**CHENGANNUR**

**MARCH 2022-2023**

# **CHRISTIAN COLLEGE**

**CHENGANNUR**



## **BONAFIDE CERTIFICATE**

Certified that the project report entitled “**Investigation of the structural properties of reduced graphene oxide (RGO) via green hydrothermal method at different temperatures**” is a bonafide work of ARDRA SAJEEV carried out under my supervision at Christian college, Chengannur.

**Dr. VINOY THOMAS**

## **ABSTRACT**

Preparation of RGO from graphene oxide (GO) is recognized as one of the most promising methods for large-scale and low-cost production of graphene-based materials. An environmentally friendly method has been applied for the preparation of RGO. Hydrothermal synthesis is one of the most usually used approach for the synthesis of nanomaterials. In hydrothermal synthesis, the controlled morphologies of nanomaterials are obtained in low- or high-pressure conditions, in a wide temperature range ranging from room temperature to relatively high temperatures. The present work mainly focussed on the synthesis of RGO via a simple hydrothermal method by varying the reaction temperature and to investigate its structural and optical properties. The first chapter is a general introduction about the material used in the study The second chapter deals with the experimental procedure and the detailed working principle of different characterizations used for the analysis. The final chapter is a comprehensive report on the results obtained and further discussion. The future scopes of the current study are also briefly stated.

# **Hydrothermal route to graphene quantum dots (GQDs): Effects of temperature**

A Project report submitted to the  
University of Kerala

For the partial fulfilment of the requirements for the Degree of

**MASTER OF SCIENCE IN**

**PHYSICS**

By

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**Dr. VINOY THOMAS**

## **ABSTRACT**

Being a zero-dimensional (0D) carbon nanomaterial, graphene quantum dots (GQDs) exhibited promising applications in many fields varying from energy to environment owing to their small size, non-toxicity, biocompatibility, outstanding photo stability, tunable fluorescence, and water solubility, etc., thus capturing a considerable attention. The present work mainly focussed on the synthesis of GQDs via a simple hydrothermal method and to investigate its structural and optical properties. The first chapter is a general introduction about the material used in the study. The second chapter deals with the experimental procedure and the detailed working principle of different characterizations used for the analysis. The final chapter is a comprehensive report on the results obtained and further discussion. The future scopes of the current study are also briefly stated.



**DR. INDULAL C.R.**

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## CERTIFICATE

This is to certify that the dissertation entitled "**Structural, optical and viscous studies of Barium Oxide nanofluid**" submitted to the University of Kerala in partial fulfilment of the requirement for the award of the degree of **MASTER OF SCIENCE IN PHYSICS** is a record of original research work done by **ANJALI.S** during the period 2021-2023, under my guidance at St. Gregorios College, Kottarakkara.

Dr. Indulal.C.R.

## CHAPTER-1

### ABSTRACT

Nanoparticles may be defined as those particles having size in between 0.1 and 100 nm. Nanoparticles have zero dimensions. That is, particles have nano size in all three dimensions. The term is sometimes used for larger particles, up to 500 nm, or fibres and tubes that are less than 100 nm in only two directions. Nanoparticles are usually distinguished from “fine particles (sized between 100 and 2500 nm), and “coarse particles” (ranging from 2500 to 10,000 nm), because their smaller size drives very different physical or chemical properties, like colloidal properties and ultrafast optical effects or electric properties.

Nanoparticle synthesis is one of the complex processes. There are three main categories of nanoparticle synthesis and these are vapor phase, solution precipitation and solid-state processes. Characterization has been carried out using different techniques, mainly drawn from material science. In the present work, samples are characterized through X-ray diffraction spectroscopy (XRD), Ultraviolet (UV) spectroscopy. The optical band gap of the sample is calculated through the Tauc's relation by the analysis of UV graph.

Barium oxide is a white hygroscopic non-flammable compound. It has a cubic structure and it is used in cathode ray tubes, crown glass and catalysts. It is prepared by heating barium carbonate with coke, carbon black or tar or by thermal decomposition of barium nitrate.

*Structural, optical and viscous studies of  
Barium Oxide nanofluid*

*Project report submitted to the  
University of Kerala*

*In partial fulfilment of the requirements for the award of the  
Degree of*

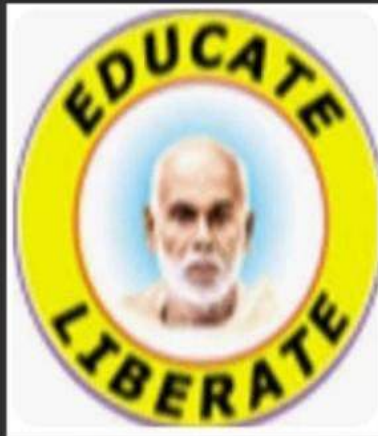
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# **Experimental investigation on thermal conductivity of Strontium Oxide Nano fluid**

*Project report submitted to the*

*University of Kerala*

*In partial fulfillment of the requirements for the award of the Degree of*

**MASTER OF SCIENCE**

**IN PHYSICS**

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## **CERTIFICATE**

This is to certify that the dissertation entitled **“Experimental investigation on thermal conductivity of Strontium Oxide Nano fluid”** submitted to the **University of Kerala** in partial fulfillment of the requirement for the award of the degree of **MASTER OF SCIENCE IN PHYSICS** is a record of original research work done by **GREESHMA BABU** during the period 2021-2023, under my guidance at St.Gregorios College, Kottarakara.

Dr. Indulal.C.R.



## CHAPTER-I

### ABSTRACT

The word "Nano" is derived from a Greek word "NANOS" which means very small or dwarf. The particles with 1 and 100 nanometers size are termed as nanoparticles. Undetectable by the human eye, nanoparticles can exhibit significantly different physical, chemical, optical, magnetic and other properties. These emergent properties may have huge implication in electronics, medicine and other fields. Michael Faraday synthesized colloidal gold particle in 1857, which was one of the important findings. Nanoparticles can be prepared easily by different physical, chemical and biological approaches. In the present work, samples were characterized through X-ray diffraction spectroscopy and Ultraviolet-visible spectroscopy. The optical band gap of the sample was calculated through the Tauc's relation by the analysis of the UV graph and the thermal conductivity of Nano fluid was studied in detail.

Strontium oxide is formed when strontium reacts with oxygen. It is a strongly basic oxide. Strontium oxide was used to make television picture tube glass. It finds application in glass, optic and ceramic industries. It is an active component of paint dryers.



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## CERTIFICATE

This is to certify that the dissertation entitled **“Structural and optical bandgap analysis of a novel heterogeneous nanocomposite”** submitted to the University of Kerala in partial fulfilment of the requirement for the award of the degree of **MASTER OF SCIENCE IN PHYSICS** is a record of original research work done by **SANDEEP KUMAR S** during the period 2021-2023, under my guidance at St. Gregarious College, Kottarakara.

Dr. Indulal C.R.

## ABSTRACT

Nanomaterials are not only a hotbed of discovery but also a burgeoning economic field with a wide range of applications. Nanomaterials are fascinating because they exhibit peculiar optical, magnetic, electrical, and other properties at such a small scale. These emergent properties may have huge implications in electronics, medicine, and other fields. Nanomaterials have a long and illustrious past. Michael Faraday synthesized colloidal gold particles in 1857, which was one of the first scientific findings. For over 70 years, nanostructured catalysis has been studied. Nanoparticle synthesis is one of the complex processes. There are several methods for creating nanoparticles, including gas condensation, attrition, chemical precipitation, ion implantation, pyrolysis, and hydrothermal synthesis. Characterization is necessary to establish understanding and control of nanoparticle synthesis and applications. Characterization has been carried out using different techniques; mainly drawn from material science.

**Barium oxide** is a white hygroscopic non-flammable compound. It has a cubic structure and it is used in cathode ray tubes, crown glass and catalysts. It is prepared by heating barium carbonate with coke, carbon black or tar or by thermal decomposition of barium

**Strontium oxide** is formed when strontium reacts with oxygen. Burning strontium in

air results in a mixture of strontium oxide and strontium nitride. It also forms from the decomposition of strontium carbonate  $\text{SrCO}_3$ .

In the present work, Nanocomposite of Barium Strontium Oxide was synthesized through the chemical co-precipitation method and there after they are characterized through X-ray diffraction spectroscopy and Ultraviolet-Visible spectroscopy. The optical bandgap of the sample is calculated through the Tauc's relation by the analysis of the UV graph.

# *Structural and optical bandgap analysis of a novel heterogeneous nanocomposite*

*Project report submitted to the  
University of Kerala*

*In partial fulfilment of the requirements for the award of the  
Degree of*

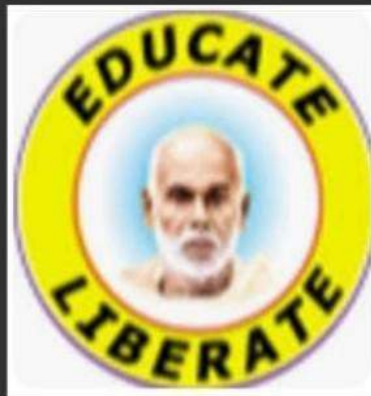
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**STRUCTURAL AND OPTICAL  
PROPERTIES CNT INTERCALATED  $\text{In}_2\text{S}_3$   
THIN FILM**

Project report submitted to the University of Kerala for the partial fulfilment of the  
Requirement for the degree of

**MASTER OF SCIENCE  
IN  
PHYSICS**

By

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**MARCH 2023**



## ABSTRACT

The present study reports the synthesis of photosensitive carbon nanotube (CNT) intercalated indium sulphide ( $\text{In}_2\text{S}_3$ ) nanocomposite thin films by using chemical bath deposition coupled with the spin coating technique. The impact of incorporation of CNT in  $\text{In}_2\text{S}_3$  thin films is compared with that of pure  $\text{In}_2\text{S}_3$  films and is discussed in detail by evaluating their structural, optical and photocatalytic properties. The structural, optical and optoelectronic properties are systematically studied as a function of thickness. The crystalline structure of thin film is studied by GIXRD. GIXRD measurement indicate the presence of  $\text{In}_2\text{S}_3$  with a stable  $\beta$ -tetragonal phase. From optical absorption studies, band gap was determined and this is compared with thickness of the films. As the thickness increases, the band gap energy of the  $\text{In}_2\text{S}_3$ -CNT nanocomposite thin film decreases.  $\text{In}_2\text{S}_3$  nanostructured material is highly desirable, which can efficiently decompose the organic pollutant molecules under light illumination. The methylene blue was employed as a representative dye pollutant to evaluate the photocatalytic activity of the samples. All the nanostructured materials showed an enhancement of the photocatalytic activity with respect to the thin films.



MARIAN COLLEGE  
KUTTIKKANAM  
(AUTONOMOUS)

MAKING COMPLETE

*Reaccredited by Naac with A++ grade (cgpa 3.71/4)*

## Department of physics

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**MARCH 2023**

### **CERTIFICATE**

This is to certify that the project report entitled “**STRUCTURAL AND OPTICAL PROPERTIES CNT INTERCALATED  $\text{In}_2\text{S}_3$  THIN FILM**” submitted in partial fulfilment of the requirement for the award of the Degree of Master of Science in physics is the bonafide work done by **ASWATHI ASHOK (Reg.No 63021128003)** of MSc physics (2021-2023) under my guidance and supervision at department of physics, Marian college (Autonomous) kuttikkanam.

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# **PHOTOCATALYSIS STUDY OF GRAPHENE: In<sub>2</sub>S<sub>3</sub> NANOCOMPOSITE THIN FILMS**

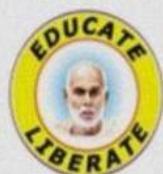
A project report submitted to the University of Kerala for the partial fulfilment Of the  
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## ABSTRACT

Recently, 2D-layered nanostructures have aroused huge interest for environmental remediation applications.  $\text{In}_2\text{S}_3$  nanosheets and 0.01 graphene doped  $\text{In}_2\text{S}_3$  nanosheets were fabricated by using chemical bath deposition coupled with the spin coating technique. The impact of incorporation of graphene in  $\text{In}_2\text{S}_3$  thin films is compared with that of pure  $\text{In}_2\text{S}_3$  films and is discussed in detail by evaluating their structural, optical and photocatalytic properties. Optical absorption studies indicate the reduction in optical bandgap due to the incorporation of graphene. Photocatalytic properties are studied using methylene blue dye. During the decoloring process of methylene blue, the average apparent rate for the as-synthesized composites with 1% graphene was almost 5 times higher than that of pure  $\text{In}_2\text{S}_3$ . This work provides new insights into utilizing  $\text{In}_2\text{S}_3$ /graphene nanocomposites as high-efficiency visible-light-driven photocatalysts for environmental remediation and energy conversion.



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## Department of Physics

---

JULY 2023

### CERTIFICATE

This is to certify that this project report "**PHOTOCATALYSIS STUDY OF GRAPHENE: In<sub>2</sub>S<sub>3</sub> NANOCOMPOSITE THIN FILMS**" submitted in partial fulfilment of the requirement for the award of the Degree of Master of Science in physics is the bonafide work done by **KAVITHA K M** (Reg.No. 6302118007) of MSc Physics (2021-2023) under my guidance and supervision at Department of Physics, Marian college (Autonomous) Kuttikkanam.

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**PHYTO MEDIATED BIOGENIC SYNTHESIS OF SILVER  
NANOPARTICLES USING LEAF EXTRACT OF *JUSTICIA ADHATODA*  
AND ITS APPLICATIONS**

*Thesis submitted to*  
**UNIVERSITY OF KERALA**

*For the partial fulfillment of the requirement for the award of the degree of*

**MASTER OF SCIENCE IN CHEMISTRY**

Submitted by  
**AJIL S B**  
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**May - 2023**

## SUMMARY

A critical milestone in the realm of nanotechnology is the development of dependable and environmentally friendly processes for the synthesis of nanoparticles. In the last decade, numerous efforts have been made to develop green synthesis methods to avoid hazardous byproducts. Silver nanoparticles are important because of their exceptional chemical, physical and biological properties, and diverse applications. This study reports a facile, ecofriendly, reliable, and cost-effective synthesis of silver nanoparticles using the aqueous leaf extract of *Justicia adhatoda* and their applications. Various methods, including UV-visible spectroscopy and X-ray diffraction (XRD), were used to characterize the biosynthesized *Justicia adhatoda* silver nanoparticles. UV-Vis spectroscopy showed a characteristic SPR peak of AgNPs at 475nm. In the XRD analysis, four peaks at  $2\theta$  values of  $38.45^\circ$ ,  $44^\circ$ ,  $64^\circ$ , and  $77.4^\circ$  in the experimental diffractogram have been identified to be due to silver metal.

The synthesized AgNPs show different applications, such as antibacterial and anti-fungal activity, and can also be used as a heavy metal biosensor. The silver nanoparticles showed excellent antibacterial activities against gram-positive (*Staphylococcus aureus*) and gram-negative (*Escherichia coli*) microorganisms. Their anti-fungal activity was tested against *Aspergillus niger* and *Candida albicans*, where NPs show more activity than standard antimycotics.

**Graphitic carbon nitride/graphene oxide nanohybrid for the adsorptive removal  
of methyl orange from wastewater**

Project report submitted to Kerala University in partial fulfilment for  
the award of the Degree of

**MASTER OF SCIENCE in CHEMISTRY**

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## ABSTRACT

Contamination of toxic organic pollutants is a worldwide problem and needs to develop an ecofriendly and highly effective adsorbent material for its removal recently graphene oxide (GO) and graphitic carbon nitride (g-C<sub>3</sub>N<sub>4</sub>) is mostly used as an adsorbent for the efficient removal of organic pollutants. In this study, GO is made using Hummer's process, and polyethyleneimine is used to change neutral g-C<sub>3</sub>N<sub>4</sub> into positively charged species. The g-C<sub>3</sub>N<sub>4</sub> and GO solutions were combined, and the resulting combination underwent a 7-hour sonication process. The as-prepared GO-g-C<sub>3</sub>N<sub>4</sub> has a sheet-like shape in which the g-C<sub>3</sub>N<sub>4</sub> nanohybrid is effectively infolded by thin, flexible GO shells. Using the anionic dye methyl orange (MO), the GO-g-C<sub>3</sub>N<sub>4</sub> hybrid's adsorptive properties were assessed. Methyl orange (MO) dye absorption was examined as a function of solution pH, adsorbent dosage, contact time, and temperature on GO-g-C<sub>3</sub>N<sub>4</sub> hybrid composite. Additionally evaluated were the adsorbent's adsorption kinetics, thermodynamics, stability, and reusability. Thermodynamics, stability, and reusability of the adsorbent were all carefully examined as well. The outcomes demonstrated that the pseudo second order is a good fit for the adsorption kinetics, equilibrium, and adsorptions. Even after repeated recycling, the GO-g-C<sub>3</sub>N<sub>4</sub> adsorbent demonstrated simple regeneration, great stability, and good sustainability in removal efficiency. The outcomes showed that GO-g-C<sub>3</sub>N<sub>4</sub> composite has a high potential for removing anionic dye contaminants in environmental remediation and is an effective and recyclable adsorbent.



**SYNTHESIS AND STUDY OF DITHIOBENZOTHIADIAZOLE  
BASED DONOR -  $\pi$  - ACCEPTOR SYSTEM  
FOR HEAVY METAL DETECTION**

Dissertation submitted to the University of  
Kerala in partial fulfilment of the requirements

for the degree of



**MASTER OF SCIENCE IN CHEMISTRY**

By

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## ABSTRACT

An Organic Donor-Acceptor (D-A) system is a well-known design where molecules are arranged to attach the electron-donating group to the electron accepting group via a bridge. The bridge can be covalent, covalent conjugated, or a non-covalent. The electronic coupling between the donor and the acceptor depend on the type of bridge, the difference in ionization potential (IP) and electron affinity (EA) of donor and acceptor group and manifest in the form of charge transfer (CT). The charge transfer (CT) or the full electron transfer between the donor/acceptor pair is the most important fundamental process in the chemical and biological processes such as photosynthesis and metabolism. In  $\pi$ -conjugated systems, the CT process has attracted much attention due to their immense technological applications in organic electronics and Photovoltaics, such as bulk heterojunction solar cells or dye-sensitized solar cells, organic light-emitting diodes (OLEDs), nonlinear optics (NLO), fluorescence sensing, and so on. In our study we synthesized two Benzothiadiazole based dye, one is Mercaptoacetic acid based and other is Cyanoacetic acid based. And study different metal ion sensing on dyes mainly focused on Mercaptoacetic acid dye.

**SYNTHESIS OF ALPHA CHITIN & BETA CHITIN  
NANOFIBERS AS A BIOBASED REINFORCEMENT FOR  
PVA/Fe(III) NANOCOMPOSITE FILMS – FABRICATION -  
MECHANICAL & ABSORPTION STUDIES**

*Thesis submitted to the Department of Chemistry, Amrita Vishwa Vidyapeetham, in partial  
Fulfilment of the Requirements for the Award of the Degree of*

MASTER OF SCIENCE

IN

CHEMISTRY

By

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Under the guidance of

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**AMRITA VISHWA VIDYAPEETHAM, AMRITAPURI CAMPUS**

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## ABSTRACT

Chitin is a value-oriented mucopolysaccharide raw source for the advanced biomedical industry. Recent developments in the strategies for the effective utilization of tons and tons of biowastes can be promising steps towards green chemistry and sustainable development. Chitin is found in nature in three polymorphic forms:  $\alpha$ -,  $\beta$ -, and  $\gamma$ -chitin. The most available form of chitin is  $\alpha$ , followed by  $\beta$  chitin. In this research,  $\alpha$  and  $\beta$  polymorphs of chitin are extracted from their sources, and nanoparticles of  $\alpha$  and  $\beta$  forms are synthesized. The incorporation of nanoparticles into a polymer matrix allows the development of new features that differs from the pure materials. Here,  $\alpha$  and  $\beta$  Chitin nanoparticles reinforced organic biodegradable polymer matrix-based biocompatible nanocomposite films are fabricated. This work covers the synthesis of  $\alpha$  and  $\beta$  chitin via chemical isolation from natural sources. The purity, crystallinity, and yield of the extracted chitin vary with the chemicals used, method adapted, and biomass source.  $\alpha$ -chitin is extracted from shrimp shells (*Metapenaeus monoceros*), and  $\beta$ -chitin is extracted from Indo-West Arabian Sea squid pens (*Uroteuthis duvaucelli*) source through traditional demineralization and deproteinization steps. Chitin nanoparticles are further synthesized and treated with Fe(III) ions producing PVA/ $\alpha$ -chitin-Fe(III) nanocomposites and PVA/ $\beta$ -chitin-Fe(III) nanocomposites through the solvent casting method.  $\alpha$ -chitin-Fe(III) particles and  $\beta$ -chitin-Fe(III) particles bring better filler-matrix interaction which increases the mechanical properties of the Polyvinyl Alcohol film. This work covers the evaluation and comparison of morphological and mechanical properties of PVA/ $\alpha$ -chitin-Fe(III) nanocomposites and PVA/ $\beta$ -chitin-Fe(III) nanocomposites. The X-ray diffraction(XRD), scanning electron microscopy(SEM), and FTIR analysis confirmed the structure, morphology, and formation of chitin and chitin nanoparticles. Fe(III)-chitin film showed absorbance in uv-visible region which enable them to be used in various biomedical fields.  $\alpha$ -chitin-Fe(III) reinforced PVA film showed the highest tensile

strength of 23.06GPa that, is 10% higher than  $\beta$ -chitin-Fe(III) films and 40% higher than neat PVA polymer. This nanocomposite may potentially be useful in various biomedical applications.

**Keywords; Chitin; Nanofibers; Polyvinyl Alcohol, Nano composites;**



# **ELECTROCHEMICAL QUANTIFICATION OF TRYPTAMINE USING ORTHO-PHENYLENEDIAMINE MODIFIED PENCIL GRAPHITE ELECTRODE**

*Thesis submitted to the Amrita Vishwa Vidyapeetham in partial fulfilment of  
the*

*Requirements for the degree of Master of Science in chemistry*



Submitted by

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Under the supervision of

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**AMRITA SCHOOL OF ARTS AND SCIENCE**

**AMRITA VISHWA VIDYAPEETHAM**

## ABSTRACT

. By means of electro polymerization process, a simple as well as efficient electrochemical sensor was developed for the electrochemical determination of tryptamine. The morphology and electrochemistry of thus fabricated poly (O-Phenylene diamine) reformed pencil graphite is evaluated thoroughly by field emission scanning electron microscopy, differential pulse voltammetry and cyclic voltammetry respectively. Under experimental settings, finely resolved irreversible electro-oxidation peak at potential +0.594 V obtained for tryptamine on the altered electrode surface with phosphate buffer of pH 9 as supporting electrolyte. The oxidation peak current and tryptamine concentration are observed to possess linearity in the range of 0.4  $\mu\text{M}$  to 117  $\mu\text{M}$  with  $R^2 = 0.99$ . The limit of detection (LOD) for the tryptamine quantification is found to be 0.2  $\mu\text{M}$ . The sensor exhibited superior analytical properties such as high reproducibility, repeatability and anti-interference capability. The practical efficiency of fabricated sensor tested successfully in cheese obtained from milk.

**Assessment of Microplastic Concentration Sediments in  
Azheekkal Beach, Kollam District, Kerala**

*Thesis submitted to*

**UNIVERSITY OF KERALA**

*For the partial fulfilment of the requirement for the award of the degree of*

**MASTER OF SCIENCE IN CHEMISTRY**

Submitted by

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श्रद्धावान् लभते ज्ञानम्

**May - 2023**



### Abstract

The global production of plastics has witnessed a continuous surge over time, contributing to a significant increase in their overall presence. Plastics have gained immense popularity owing to their remarkable characteristics such as versatility, lightweight nature, durability and transparency, rendering them exceptionally suitable for a diverse range of applications. According to different surveys, million tonnes of plastic garbage were dumped into the ocean. Due to their widespread use and the numerous additives, they become very important in human lives. Plastics present many possible risks to both human health and the environment. Micro plastics represent a prevalent form of pollution, posing risks to human health through various routes of exposure. Micro plastic pollution in the ocean is a major concern. Plastics entering the ocean have a wide range of size, colours, chemical compositions, densities and shapes. It is critical to identify any micro plastics that have collected in marine sand. Consequently, the research was done to determine the amount of micro plastics in maritime sediment.

FABRICATION OF MULTILAYERED AQUATIC WEED DERIVED FIBER FOR THE ENHANCED REMOVAL OF TEXTILE DYE

*Dissertation submitted to Kerala University in partial fulfilment for the award of the degree of*  
MASTER OF SCIENCE IN CHEMISTRY



*Submitted by*

KRISHNA SV  
Reg. No. 63521128007

DEPARTMENT OF CHEMISTRY  
SREENARAYANA COLLEGE CHENGANNUR

*Under the Guidance of*

Dr. Shanthi Prabha V



ADVANCED CENTRE OF ENVIRONMENTAL STUDIES AND  
SUSTAINABLE DEVELOPMENT (ACESSD)  
*- An inter university centre*



MAHATMA GANDHI UNIVERSITY  
KOTTAYAM-686560

MAY 2023

## ABSTRACT

The contamination of natural water emerged as one of the most significant issues facing contemporary society. This environmental issue is related to both the release of home and industrial effluent and the waste water running from its improper use. Water contamination can be treated using a variety of techniques. Adsorption is a highly effective method of recycling and purifying water that is greatly desired in the treatment of coloured wastewater. An innovative approach for removing dye from water is layer by layer (LbL) assembly. Rarely do polyelectrolytes (Pes) directly assemble on natural support materials in the LbL mode. Here, we discuss how LbL was incorporated into one of the most creative support materials that could have a long-lasting effect on how water is treated in the textile industry. By alternately exposing chitosan (CHI) and polyacrylic acid (PAA) to Eichhornia fibre, a low-cost eco friendly adsorbent is created from the two substances. Spectroscopic and microscopic methods are used to characterize the 1bl, 3bl, 5bl Eichhornia fibre. CHI/PAA multilayer coated Eichhornia fibre, also known as layered Eichhornia fibre (LEF), shown high cationic dye loading capacity. It is believed that the binding of dye molecules to LEF by electrostatic and hydrophobic interactions. In this study, Methylene Blue (MB) was taken out from aqueous solution using LEF(1bl, 3bl, 5bl EC fibre). Using the batch adsorption technique, the effects of operating variables such as LEF dosage, contact time, starting Ph, and temperature on the elimination of MB were examined and adsorption studies are done by the data. The removal efficiency of adsorbent 1bl 3bl 5bl Eichhornia fibers are compared.

**Doped g-C<sub>3</sub>N<sub>4</sub>-BiVO<sub>4</sub> composite for photocatalytic dye degradation  
and antibiotic degradation**

Project report submitted to Kerala University in partial fulfilment for  
the award of the Degree of

**MASTER OF SCIENCE in CHEMISTRY**

**By**

**MEENAKSHY A**

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**Department of Chemistry**

**Sree Narayana college, Chengannur, Alappuzha**



Under the Supervision of

**Dr. BAIJU.K. V**

**Assistant Professor**

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**Kannur University, Kerala**





## ABSTRACT

Contamination of water is a rising global crisis. Industrialisation, use of pesticides and fertilizers, use of synthetic organic dyes, inadequate waste management have intensified environmental health risks and pollution. Commonly used remedies for the elimination of pollutants are highly expensive and also have high energy cost. Nowadays, fast depletion of the non renewable sources of energy has becoming a global crisis.

Carbon based materials have outstanding physical, chemical, thermal and electrical properties. With the wealth of having attractive properties such as reliable chemical and thermal endurance, super hardness, low density, biocompatibility, water resistivity, graphitic carbon nitride become one of the most promising materials for light emitting device, photocatalysis, etc. Doping of graphitic carbon nitride is done to increase the properties like higher recombination rates, low surface area, etc, thereby broadening its application range. Typically, metal doping, nonmetal doping, co-doping and heterojunctions based on doped graphitic carbon nitride have been explored to tune the crystallographic and electronic structures for improving photocatalytic activity by enhancing the light absorption, facilitating the charge separation and transportation and prolonging the charge carrier lifetime. Bismuth vanadate, one of the most promising visible light driven semiconductor material, which shows a strong absorption in the visible region, and its response wavelength ranges up to 500 nm. In our studies, we synthesize Boron doped graphitic carbon nitride and bismuth vanadate composite and use it for catalytic applications like photodegradation of toxic pollutants and energy storage purpose like super capacitor applications.



**Adsorptive removal of organic pollutant Methylene Blue from aqueous solution  
using Graphene Oxide/Graphitic Carbon nitride nanohybrid**

Project report submitted to Kerala University in partial fulfilment for  
the award of the Degree of

**MASTER OF SCIENCE in CHEMISTRY**

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Under the Supervision of

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## ABSTRACT

Toxic organic pollution contamination is a global issue that requires the creation of an eco-friendly and highly effective adsorbent material. For the effective removal of organic contaminants, graphene oxide (GO) and graphitic carbon nitride (g-C<sub>3</sub>N<sub>4</sub>) are now primarily used as adsorbents. In this study, GO is produced using hummer's method, and neutral g-C<sub>3</sub>N<sub>4</sub> is converted to positively charged species using polyethylene imine. After combining the g-C<sub>3</sub>N<sub>4</sub> and GO solutions, the mixture underwent a 7hr sonication process. The GO/g-C<sub>3</sub>N<sub>4</sub> is a sheet like structure when it is first made, with the g-C<sub>3</sub>N<sub>4</sub> nanohybrid being inverted by the thin and flexible GO shells. The GO/g-C<sub>3</sub>N<sub>4</sub> hybrid's adsorptive qualities were evaluated using cationic dye: Methylene blue (MB). On GO/g-C<sub>3</sub>N<sub>4</sub> hybrid composite, methylene blue(MB) dye adsorption as a function of solution pH, adsorbent dosage, contact time and temperature was studied. Additionally, the adsorbent's thermodynamics, stability, and reusability were all rigorously evaluated. The results showed that the pseudo second order fits the adsorption kinetics, equilibrium, and adsorptions well. Even after multiple recycling cycles, the GO/g-C<sub>3</sub>N<sub>4</sub> adsorbent showed easy generation, remarkable stability, and good sustainability in removal efficiency. The results demonstrated the significant potential of GO/g-C<sub>3</sub>N<sub>4</sub> composite as an efficient and recyclable adsorbent for adsorbing cationic dye pollutants in environmental remediation.

# **Synthesis and Characterisation of Zein based Radiopaque Microbeads for Trans arterial Chemoembolization**

**A Dissertation Submitted to the University of Kerala in Partial Fulfilment of the Requirement for the Degree of**

**Master of Science in Chemistry**

**Submitted By  
Reshma R.S.**

**Candidate Code:**



**Department of Chemistry  
Sree Narayana College, Chengannur**

**Under the supervision of  
Dr. MANJU, S.  
Scientist E**



**Dept. Biomaterial Science and Technology  
Biomedical Technology Wing  
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**April 2023**

According to the reports of World Health Organization, Hepatocellular carcinoma (HCC) is the sixth most common cancer and is increasing in its rate of incidence. WHO estimates that more than one million people will die from HCC by 2030. Though liver resection and transplantation are the effective treatment methods, it cannot be performed for intermediate and termination stages and also when the patient is suffering from chronic liver cirrhosis. Transarterial chemoembolization (TACE) is an effective way to treat intermediate stage HCC which is proven to improve the quality of life and survival rates of patients. It involves a special type of polymeric structures called microbeads which are used as embolic agents. They will occlude the tumor feeding arteries and block the nutrient supply to the tumor. This will eventually lead to tumor death. When TACE is performed with microbeads loaded with anti-cancer drugs, it is called drug eluting bead TACE (DEB-TACE). It is a very effective treatment strategy as it causes faster tumor necrosis both due to arterial embolization and the release of anti-cancer drugs.

Microbeads are the topic of interest in oncology as they are polymer matrices fabricated in such a way that they will release the drug in a sustained manner. The controlled release of drugs will ensure desired therapeutic level of the drug in blood serum. It will reduce systemic toxicity as it targets the part or organ which is affected. Though drug delivery using microbeads is an effective strategy in liver cancer, most of the formulations available in the market are synthetic. They will permanently occlude the arteries and re-intervention of the embolization sites is not

possible if the cancer regrows. Also, tracing of the position and state of the microbead is also important in TACE. Contrast agents used for this purpose will readily wash out and make imaging impossible. This context is our area of interest. We have to find a biodegradable system with a degradation period not more than three months to fabricate microbeads that are drug-eluting and can be used for TACE. Biodegradable systems will ensure very low toxicity and recanalization as they will degrade into products that can be absorbed by the body. They also release the drugs sustainably without entering systemic circulation. They can be conjugated with an iodine containing moiety to impart radiopacity. The physicochemical properties and radiopacity of the beads can be analysed with the help of FTIR spectroscopy, DLS and Micro CT. Along with this process, we can ideally share our results and urge others to think about the applications of biodegradable radiopaque microbeads in oncology research.

**Microplastics In Mangrove Sediments, Near Azheekal  
Beach, Kollam District**

*Thesis submitted to*

**UNIVERSITY OF KERALA**

*For the partial fulfilment of the requirement for the award of the degree of*

**MASTER OF SCIENCE IN CHEMISTRY**

Submitted by

**Rohini S Pillai**

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*Under the guidance of*

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श्रद्धावान् लभते ज्ञानम्

**May - 2023**



## Abstract

The amount of plastic in the globe has been increasing every day. Global annual plastic production has increased drastically. Human society heavily depends on plastic due to their resistance to chemical, physical and biological degradation. The most urgent environmental problems today are plastic waste, which brought on by rising use of non- disposal plastics. One of the major problem the world is currently facing is the enormous increase in the amount of micro plastics in the environment. It is very difficult to detect the amount of micro plastics in the environment. Micro plastic have been observed on the shore, sea surface and seabed from the coast to the open ocean. Mangroves are a special variety of coastal wetlands that provide essential ecosystem services. The mangrove ecosystem, a crucial land-to-water barrier, has been noted as possible sink for micro plastics brought on by both marine and land- based activities. Hence determining the quantity of micro plastics in mangrove sediment is crucial. In order to determine if micro plastics are present in mangrove sediment, we conducted the investigation described above.

**Fabrication of flexible titanium nanotube electrode and its  
composite for super capacitor applications.**

Project report submitted to Kannur University in partial fulfillment for  
the award of the Degree of

**MASTER OF SCIENCE in CHEMISTRY**

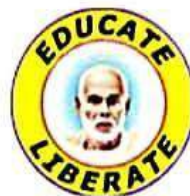
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Under the Supervision of

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## **ABSTRACT**

Super capacitors are electrochemical energy storage devices, replaceable to Li-ion batteries that can store and release energy through reversible adsorption and desorption of ions at the interfaces of electrode materials and electrolytes. Super capacitors have high power density, high energy density and fast charging – discharging ability than Li-ion batteries and thus become more attractive towards many industries such as automobiles, aerospace and telecommunication. Metal oxide materials have been a focus of research for the application in energy storage devices. Metal oxides have attractive performances for fabricating various super capacitor devices. Metal oxides are made composites with different nanomaterials such as  $V_2O_5$ ,  $TiO_2$  etc. Titanium oxides have optical properties such as transmittance absorbance, absorption coefficient, refractive index, and extinction coefficient. Application of Titanium oxide is found in semiconductors, tuned circuits, transparent heat mirrors, micro-super capacitors. Aim of the project is the fabrication of flexible metal oxide electrode and its composite for super capacitor applications. Titanium foil is anodized for the synthesis of Titanium oxide. And a simple hydrothermal method is adopted to prepare Titanium oxide/nanomaterial composites. And then we will measure the capacitance by using electrochemical work stations. The structural and surface characteristics will be investigated by X-ray powder diffraction (XRD).

# **Nanocellulose Based Biochar Membrane For Selected Textile Dye Removal From Aqueous Medium**

*Dissertation submitted to the University of Kerala in partial fulfilment of the requirements for  
the degree of*

**MASTER OF SCIENCE IN CHEMISTRY**

*Submitted by*

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**Reg. No. 63521128013**

**DEPARTMENT OF CHEMISTRY  
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**Under the guidance of**

**Dr Shanthi Prabha V**



**ADVANCED CENTRE OF ENVIRONMENTAL STUDIES AND  
SUSTAINABLE DEVELOPMENT (ACCESSD)**

*- An inter university centre*



**MAHATMA GANDHI UNIVERSITY**

**KOTTAYAM-686560**

**May 2023**



## Abstract

Dyes (colorants) are employed in many industrial applications, and numerous companies' effluents contain harmful dyes. Dyes exhibit toxicity to humans, aquatic organisms, and the environment. Therefore, dyes containing wastewater must be properly treated before discharging to the surrounding water bodies. There are various techniques for the removal of dyes from wastewater such as adsorption, oxidation process, photocatalyst, and membrane separation technology. In this work, the recent advances in the removal of dyes from wastewater by membrane technology as one of the most promising and effective water treatment methods have been explained. The present work was devoted to study the operating feasibility using membrane systems as an alternative treatment method of wastewater discharged from textile industry and highlights the routes of biochar production from aquatic weeds using pyrolysis. Biochar as an adsorbent possesses numerous advantages, such as being eco-friendly, low-cost, and easy to use; various precursors are available in abundance to be converted into biochar, it also has recyclability potential and higher adsorption capacity than other conventional adsorbents. Effects of dye concentration, pH of solution, temperature, contact time and dosage on dye rejection was studied. Results at operating conditions of dye concentration = 25 ppm in 1000 ml showed the final dye removal with ECBM membrane as 97.2%, 99.58% and 99.9% for methylene blue, and for eriochrome black t 92.77%, 94%, and 96% respectively. The results showed that membrane method had higher removal potential with lower effective cost the aim of this work is to provide an overview of the application of membrane technology using biochar as filler is an eco-friendly and economical adsorbent to remove toxic colorants (dyes) from the aqueous environment. The present work highlights the removal efficiency of membrane technology and the routes of biochar production from aquatic weeds using pyrolysis. Biochar as an adsorbent possesses numerous advantages, such as being eco-friendly, low-cost, and easy to use it also has recyclability potential and higher adsorption capacity than other conventional adsorbents. From the study, it is clear that membrane technology using biochar as filler is a vital candidate for the removal of dyes from wastewater with an adsorption capacity of above 90 %.



**EXTRACTION, IDENTIFICATION, AND  
DETERMINATION OF ANTIOXIDANT ACTIVITY FROM  
THE METHANOLIC EXTRACT OF LEAVES OF  
CATHARANTHUS ROSEUS**

*Dissertation submitted to Kerala University in partial fulfillment for the award of the degree of  
MASTER OF SCIENCE IN CHEMISTRY*



*Submitted by*

**SREELEKSHMI M S**  
( Candidate Code: 63521128014 )

*Under the supervision of*

**Dr. REJITHAMOL R**  
Assistant Professor ( Sr. Gr. )



**DEPARTMENT OF CHEMISTRY  
AMRITA SCHOOL OF PHYSICAL SCIENCES**

## ABSTRACT

Periwinkle (*Catharanthus Roseus*) is a herbaceous medicinal plant commonly known as *Vinca rosea*. It is in the family of *Apocynaceae*. Periwinkle is referred to as symbol for hope, comfort for cancer patients. It contains a variety of photochemical compounds including alkaloids, tannins, saponins, proteins, carbohydrates etc Periwinkle alkaloids used in the treatment of Hodgkin disease, leukemia etc. It is used in ornamental and medicinal purposes.

These plant extracts also contain another compounds such as phenols, glycosides , steroids provide with physiological activities and anti cancer, anti helminthic ,anti ulcer , hypotensive activities which plays potential role in medical applications targeting human health.

Qualitative methods including tests for the presence of alkaloids, carbohydrates, phenols. Quatitative methods including FRAP ,DPPH Assay and TPC were adopted to determine antioxidant activity of the methanolic extract of the plant. Spectroscopic (FT-IR, UV-Vis) Voltammetry, Chromatographic techniques determine the existence of hydroxyl and amine functional groups.

**SYNTHESIS AND PHOTOPHYSICAL STUDIES OF LOW  
BAND GAP POLYMER**

Dissertation submitted to the University of  
Kerala in partial fulfilment of the requirements  
for the degree of



**MASTER OF SCIENCE IN CHEMISTRY**

By

**SRUTHY S**

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Under the guidance of

**Dr. Vineetha P.K**

**ADVANCED MOLECULAR MATERIALS RESEARCH CENTRE, (AMMRC)**

**MAHATMA GANDHI UNIVERSITY,**

**KOTTAYAM**



**JULY 2023**

Researchers are striving for advancements in photovoltaics to transition to renewable energy. Using perovskites as light harvesters has led to stunning technological advancements in recent years. Perovskite solar cells now have a power conversion efficiency of 20% or higher, whereas established technologies took decades to reach this level. Despite all the advances in perovskite solar cells, hole transport materials (HTM) remain indispensable. An HTM layer must be present for effective charge extraction since perovskites can. To encourage further research and optimization of these materials, we provide an overview of the different types of conjugated polymers used as HTM for perovskite solar cells.

In this paper, we have planned to synthesize and study the photophysical properties of a novel donor-acceptor (D-A) conjugated polymers containing benzodithiophene (BDT) as the donor unit and the thiadiazoloquinoxaline (TQ) as the acceptor moiety, for the application as an HTM in perovskite solar cells. The BDTTQ-polymers were synthesized by a standard stille coupling polymerization. For the synthesis of polymer, we have synthesized the different derivatives of TQ and studied their photophysical properties. The thermal, optical and electrochemical properties of the copolymers were well investigated. The preliminary investigation of the resulting copolymer was characterized by FT-IR,  $^1\text{H}$  NMR spectroscopy, GPC & TGA. The optical band gap of the polymer was calculated, and the electrochemical studies revealed the HOMO and LUMO energy levels to be  $-5.25\text{eV}$  &  $-2.9\text{eV}$ , respectively, which indicated that the copolymer to be promising HTM for perovskite solar cell applications.



# **FACILE EXTRACTION AND COMPARISON OF LIGNINS FROM COCONUT SHELL**

*Thesis submitted to the Amrita Vishwa Vidyapeetham in partial fulfilment  
of the requirements for the degree of*

**MASTER OF SCIENCE IN CHEMISTRY**

*Submitted by*

**VISMAYA VV**

**(Candidate Code: 63521128016)**

*Under the supervision of*

**Dr. SARITHA A**

**Associate Professor**

**Department of Chemistry**



**DEPARTMENT OF CHEMISTRY  
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KOLLAM, KERALA, INDIA-690525**



## **Abstract**

Lignin is a complex organic polymer found in the cell walls of plants. It is the most abundant natural polymer on Earth, after cellulose. Lignin provides structural support to plants and is responsible for their rigidity and strength. The extraction of lignin can be achieved through various methods. Lignin extraction process can vary depending on the source of lignin and the desired purity level. Different lignocellulosic materials may require tailored extraction methods like kraft, sulphite, organosolv and soda process. Lignin has a wide range of application for its unique properties and it has gained attention for various biomedical applications. In this study, we extracted lignin from coconut shell. Coconut shell contains large amount of lignin and it is underutilized for the production of lignin. Here we extracted lignin from coconut shell powder through soda process. Various drying method were used and the properties and characteristics are compared.

2020-2022

AISWARYA S



# N.S.S. COLLEGE, PANDALAM

Re-Accredited by NAAC with B+ Grade

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KERALA STATE

Ph: 04734 252221

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## CERTIFICATE

This is to certify that the project report entitled "*Synthesis of Cadmium Sulphide Nanoparticles by Solid State Method*" submitted by AISWARYA S in partial fulfillment of the requirements for the award of Master of Science in Physics at Sree Narayana College, Chengannur is an authentic work carried out by her at PG & Research Department of Physics, N S S College, Pandalam during the period from 4<sup>th</sup> April 2022 to 31<sup>st</sup> August 2022 under my supervision and guidance. The thesis has not formed the basis for the award of any other degree, diploma or similar title of any other university or institution.



Dr. Saravana Kumar S

Dr. S. SARAVANA KUMAR  
Assistant Professor  
Department of Physics  
NSS College, Pandalam

## Abstract

CdS nanoparticles were created in the current study using the arrested precipitation approach. When the samples' X-ray diffraction patterns were recorded and compared to the benchmark JCPDS values, it was discovered that the samples in the current investigation are in cubic phase. The Debye-Scherrer equation was used to determine the grain size of the samples, which was discovered to be around 7 nm. According to calculations made from UV- visible absorption experiments, the band gap of CdS nanoparticles is 4.9 eV. CdS nanoparticles' larger band gap as compared to their bulk counterparts is evidence of the quantum confinement effect. At room temperature, the samples' PL spectra were captured using an excitation wavelength of 290 nm. Band edge emission is responsible for the peak at about 350 nm. The peak at 401 nm can be attributed to sulphur vacancies, or more specifically, to the recombination of holes at the valance band with electrons at the sulphur vacancy.

ARDHANA CHANDRAN V S

भारत सरकार  
पृथ्वी विज्ञान मंत्रालय  
भारत मौसम विज्ञान विभाग  
मौसम विज्ञान केंद्र  
विकास भवन (डाक)  
तिरुवनंतपुरम



Government of India  
Ministry of Earth Sciences  
India Meteorological Department  
Meteorological Centre  
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Pincode-695033

No. AWS-0300/(100 AWS)/CERT-24

dated 27/09/2022

### CERTIFICATE

Certified that the project report entitled "Study of heavy rainfall in summer" is a bona fide work of Ardhana Chandran carried out under my supervision at India Meteorological Department, Thiruvananthapuram

P. S. Biju  
Scientist-E/Director  
(India Meteorological Department)  
(Ministry of Earth Sciences)  
(Govt. of India)

Nodal Officer(AWS & Radar projects)

## ABSTRACT

The main objective of the project is to study the heavy rainfall in summer season. We took the data of 29 years and studied the data precisely. The districts chosen for this project is based on the geography of Kerala, that is coastal, midland and high range area. Alapuzha, Kottayam and Idukki are mainly known for the heavy rainfall, thus these districts were chosen. During the study of the data we draw graphs for each rain gauge station of the three districts to know the accurate maximum and minimum value of rainfall that was received by each rain gauge station during each year. Since we consider continuous 29 years we can take an average value and have an assumption about the amount of rainfall. In the following years which month will we receive maximum and minimum rainfall can also be predicted. Similar to the above work, this project also aims the study of heavy rainfall during summer season in Kerala by analysing the monsoon data over 29 years. By analysing these data, we are able to understand which stations received high, very high and extreme rainfall during the pre-monsoon season.

In this project I mainly concentrated on the summer heavy rainfall of the three districts which get affected dreadfully during all the year. The 29 years data was collected and studied to make a clear idea about the rainfall in summer season.



ARYA M NAIR



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### CERTIFICATE

This is to certify that the project report entitled "*Synthesis of Zinc Sulphide Nanoparticles by Solid State Method*" submitted by ARYA M NAIR in partial fulfillment of the requirements for the award of Master of Science in Physics at Sree Narayana College, Chengannur is an authentic work carried out by her at **PG & Research Department of Physics, N S S College, Pandalam** during the period from 4<sup>th</sup> April 2022 to 31<sup>st</sup> August 2022 under my supervision and guidance. The thesis has not formed the basis for the award of any other degree, diploma or similar title of any other university or institution.



Dr. Saravana Kumar S

Dr. S. SARAVANA KUMAR  
Assistant Professor  
Department of Physics  
NSS College, Pandalam

## ABSTRACT

Over the past few years, interest in these materials has increased due to their new quantum confinement effect-derived capabilities. II-VI semiconductors with wide band gaps make excellent study materials for discrete state research in the energy gap. ZnS is a desirable candidate for use in innovative photonic devices that operate in the near-IR to visible light spectrum. In the current work, arrested precipitation method was used to synthesize nanoparticles. The Debye-Scherrer equation was used to determine the grain size of ZnS nanoparticles, which was determined to be roughly 3 nm. From the calculations using UV-Visible absorption spectrum, the band gap of ZnS nanoparticles is 4.5 eV, which is greater than the band gap of bulk ZnS. At room temperature, the samples' PL spectra were recorded using an excitation wavelength of 330 nm. In the pristine ZnS samples, the emission peak at 407 and that at 434 were attributed to the radiative transitions between acceptor level and conduction band and between valance band and donor level, respectively. It was determined that the peak at 462 nm represented radiative transitions between the two trap levels.

ASWATHY J S

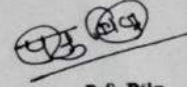


No. AWS-0300/(100 AWS)/CERT-25

dated 27/09/2022

CERTIFICATE

Certified that the project report entitled "Climatology of coastal stations" is a bona fide work of **Aswathy J S** carried out under my supervision at India Meteorological Department, Thiruvananthapuram



**P. S. Biju**  
Scientist-E/Director  
(India Meteorological Department)  
(Ministry of Earth Sciences)  
(Govt. of India)

Nodal Officer (AWS & Radar projects)

## ABSTRACT

Climate change is one of the major threats that coastal areas facing, and these coastal areas already stressed by human activity and large populations. Coastal areas are also home to species and habitat that provides many benefits to society and natural ecosystems. Coasts are sensitive to sea level rise, changes in the frequency and intensity of storms, increase in the precipitation, and warmer ocean temperatures. The shoreline erosion, coastal flooding, water pollution, is already a concern in many areas of Kerala coast.

This project aims, the study of climate change of the coastal stations such as, Thiruvananthapuram and Alappuzha, by analysing the data of past fifty-one years from 1969-2020. Here, we are taking the data which includes the maximum and minimum temperatures, and rainfall experienced during each month in every year. By calculating the average of temperatures and rainfall, plotting the required graphs we can analyse the variations that occurred and thereby we are able to predict the further weather conditions. By observing those data, we can also say that on which year and which month these stations received maximum and minimum temperature and rainfall, average temperature experienced by each station, which station undergo high climate change. We can also predict how these climatic variations affect the global temperature. This study also helps us to predict the overall climate changes that happened during these years.



**BINIL G EDWIN**

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Government of India  
Ministry of Earth Sciences  
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No. AWS-0300/(100 AWS)/CERT-21

dated 27/09/2022

**CERTIFICATE**

Certified that the project report entitled "**Climatology of Inland Stations**" is a bona fide work of **Binil G Edwin** carried out under my supervision at India Meteorological Department, Thiruvananthapuram

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**HARISHANKER**



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---

OCT 2022

**CERTIFICATE**

Certified that the project report entitled "SYNTHESIS AND OPTICAL STUDIES OF CARBON QUANTUM DOTS" is a bona fide work of **HARISHANKER** carried out under my supervision at Christian College,Chengannur.

**Dr. VINOY THOMAS**

**ASSOCIATE PROFESSOR AND**

**HEAD OF THE DEPARTMENT**

**KEERTHI S S**

Department of Physics  
N S S College , Pandalam  
Alappuzha

Accredited by NAAC and affiliated to University of Kerala

Sir, HAREESH P S  
Assistant professor  
Department of Physics  
N S S College Pandalam  
Alappuzha

This is to certify that the project report entitled "SYNTHESIS STUDY AND CHARACTERIZATION OF CERIUM OXIDE NANOPARTICLES" submitted by KEERTHI S S is partial fulfillment of the requirements for the award of Master of Science in Physics at Sree Narayana College ,Chengannur, is an authentic work carried out by her at Department of Physics , N S S College Pandalam , Alappuzha during the period from 23<sup>rd</sup> May 2022 to 1<sup>st</sup> August 2022 under my supervision and guidance. The thesis has not formed the basis for the award of any other Degree , Diploma ,Associate ship , Membership or similar title of any University or Institution.

  
Sir, HAREESH P S

## Abstract

Nanoparticles of rare earth oxides, in particular, cerium oxide, has been extensively studied due to its commercial applications as a catalyst, oxygen sensor, solid electrolyte, and absorbent, among others. It is well known that rare earth oxides were used as catalysts in a wide variety of reactions of industrial and environmental interest. These oxides has a high oxygen mobility and storage capacity, and can act as a local source or sink for oxygen involved in reactions taking place on its surface. In the present work, nanoparticles of ceria were synthesized using chemical precipitation technique using Cerium (III) nitrate hexa hydrate and Sodium hydroxide as precursors. The nanoparticles of Cerium oxide were also synthesized using tri Ethanol Ammine (TEA) as the surfactant. The XRD pattern of nanoparticles of ceria were recorded. From the XRD pattern it was observed that ceria nanoparticles of present study are in cubic phase. The grain size of the particles calculated from XRD pattern is about 10nm. The band gap of nanoparticles of ceria calculated from UV- visible spectrum absorption is about 4.95eV. It is found that there is an increase in band gap as compared with bulk material. The photoluminescence spectra was also recorded. The emission peak was observed at 404nm and is less compared to the band gap of ceria. The emission peak can be attributed to radiative transitions between defects levels due to oxygen vacancies.



LIJINA JOY

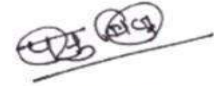
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|--|---|---|

No. AWS-0300/(100 AWS)/CERT-23

dated 27/09/2022

**CERTIFICATE**

Certified that the project report entitled "Study of heavy rainfall in Northeast monsoon" is a bona fide work of Lijina Joy carried out under my supervision at India Meteorological Department, Thiruvananthapuram



**P. S. Biju**  
Scientist-R/Director  
(India Meteorological Department)  
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Nodal Officer (AWS & Radar projects)

**SAMYUKTHA SURESH**

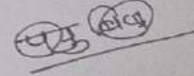
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|--|---|---|

No. AWS-0300/(100 AWS)/CERT-22

dated 27/09/2022

**CERTIFICATE**

Certified that the project report entitled "Study of heavy rainfall in Southwest monsoon" is a bona fide work of **Samyuktha Suresh** carried out under my supervision at India Meteorological Department, Thiruvananthapuram



**P. S. Biju**  
Scientist-E/ Director  
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(Ministry of Earth Sciences)  
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Nodal Officer (AWS & Radar projects)

## ABSTRACT

The South-west monsoon is the rainy season that lasts from June to September. The South-west monsoon is the Indian subcontinent's primarily rainy season. The South-west monsoon holds over the country during the summer monsoon season. During this time, the country receives nearly 75% of its annual rainfall. Rainfall is very important for the survival of plants and animals. It brings fresh water to the earth's surface. If rainfall is less, there is water scarcity which sometime causes drought like situation. If there is excess rain, floods take place which make the life of the affected people miserable.

In this project, the study of south-west monsoon in lowland, midland and highland, by analysing the data of past 29 years (1991-2020). Here, the data which includes the average of 29 years of mean rainfall, rainy days, frequency of occurrence of heavy rainfall, very heavy rainfall and extremely heavy rainfall in each stations. With this data, we can plot the graph of these corresponding data and analyse it. By observing those data, we can predict the maximum and minimum rainfall, rainy days, frequency of occurrence of heavy rainfall, very heavy rainfall and extremely heavy rainfall in each station.

**SARATH S PILLAI**



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**(Affiliated to Mahatma Gandhi University, Kottayam, Kerala)**

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**Dr. Jinemon Cyriac**  
**Assistant Professor**

**September 2022**

**Certificate**

This is to certify that the project work entitled, “**STRUCTURAL AND CHARACTERISTIC STUDIES OF PURE ZINC SULPHIDE**” is an authentic record of the work carried out by **Sarath S Pillai**, under my guidance and supervision, at Marian College Kuttikkanam (Autonomous) in partial fulfillment of the requirements for the award of Master of Science in Physics. I further certify that this work or part of it has not previously formed the basis for the award of any degree or diploma.

**Dr. Jinemon Cyriac**



## ABSTRACT

This work is focussed to understand the zinc sulphide nanoparticles including their structure, properties and applications. It also provides a specific framework for advancements in zinc sulphide nanophosphor. It focuses on the techniques of preparing zinc sulphide with discussion on its applications. Optical characterisation of the sample was carried out by X-Ray diffraction and Photoluminescence spectroscopy. Hence this work will be of immense use, particularly to the researchers working on optoelectric application.

SRUTHI S



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October 2022

**CERTIFICATE**

This is to certify that the project work entitled, “**SYNTHESIS OF CARBON QUANTUM DOTS AND STUDY OF OPTICAL AND MORPHOLOGICAL PROPERTIES**” is an authentic record of the work carried out by **Sruthi S**, under my guidance and supervision, at Christian College, Chengannur in partial fulfilment of the requirements for the award of Master of science in Physics, from Kerala University.

**Dr VINOY THOMAS**

**Associate Professor**

**Head of the Department of Physics**

## ABSTRACT

Nanoscience is an emerging area of science which involves the study of materials on an ultra-small scale and the novel properties that these materials demonstrate. It has the potential to reshape the world around us. It could lead to revolutionary breakthroughs in fields ranging from manufacturing to health care. As a research area nanoscience has seen a burst of scientific and industrial interest over the last few years. Carbon Quantum Dots are a new class of carbon nanomaterials sized below 10nm. It has attracted tremendous attention due to their unique PL properties, biocompatibility, electrochemical luminescence property and low toxicity. Here we focused to synthesis carbon quantum dots from d-glucose anhydrous through hydrothermal method at 110° C for different concentration. The solution is prepared and its optical property is observed through UV-Vis absorption and observed a broad range of absorption in the UV region i.e. at 280 nm with their peak intensities were different because of the particle concentration. The band gap is calculated using Tauc plot method. The carbon quantum dot exhibit photoluminescence and the emission is maximum is centred in green color emission region. The morphology of the synthesised material observed using transmission electron microscopic technique. The average size of the particle is found to be around 4nm.

The chapter 1 deals with an introduction to Nano materials, Quantum Dots, Carbon Quantum Dots and their classification, properties and its applications in various fields are discussed. The review of literature is also included in it.

In chapter 2 a brief description on the experiment techniques used for the synthesis of carbon quantum dots from D-glucose anhydrous at 110° C for different concentrations. And also describes the characterisation techniques of carbon quantum dots.

VISHNU PV



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Dr. Jincmon Cyriac  
Assistant Professor

September 2022

**Certificate**

This is to certify that the project work entitled, "STRUCTURAL AND CHARACTERISTIC STUDIES OF PURE AND SAMARIUM DOPED ZINC SULPHIDE" is an authentic record of the work carried out by Vishnu PV, under my guidance and supervision, at Marian College Kuttikkanam (Autonomous) in partial fulfillment of the requirements for the award of Master of Science in Physics. I further certify that this work or part of it has not previously formed the basis for the award of any degree or diploma.

Dr. Jincmon Cyriac

**Dr. JINCEMON CYRIAC**  
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2019-2021

**ROOIBOS TEA MEDIATED SYNTHESIS  
AND STRUCTURAL ANALYSIS OF  
 $Cu_{0.3}Zn_{0.7}SnO_3$  NANOPARTICLES**

*A project report submitted to the University of Kerala For the partial  
fulfillment of the Requirements for the Degree of*

**MASTER OF SCIENCE  
IN PHYSICS**

By

**AKHILA ANIL**

**Reg. No 63019128001**



**SREE NARAYANA COLLEGE  
CHENGANNUR  
UNIVERSITY OF KERALA**

*Under the guidance of*

**ARUN. S.PRASAD**

**ASSISSTANT PROFESSOR**

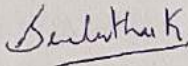
**DEPARTMENT OF PHYSICS**

**T.K.M.M COLLEGE NANGIARKULANGARA**

2019 – 2021

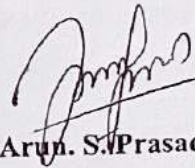
## CERTIFICATE

This is to certify that this project report entitled "ROOIBOS TEA MEDIATED SYNTHESIS ANALYSIS OF  $\text{Cu}_{0.3}\text{Zn}_{0.7}\text{SnO}_3$  NANOPARTICLES" is a bona-fide record of the work done by AKHILA ANIL under guidance and supervision of Dr ARUN S PRASAD , T.K.M. M COLLEGE NANGIARKULANGARA in partial fulfillment of the requirement for the award of the Degree of Master of Science in Physics, from Kerala University.



**Dr. SREELATHA**

**Head of the Department**



**Dr. Arun. S. Prasad**

**Assistant Professor**

**Supervising Guide**

**Examiners**

1.

2.

**Chengannur**

## ABSTRACT

The biosynthesis of  $\text{Cu}_{0.3}\text{Zn}_{0.7}\text{SnO}_3$  nanoparticles via *Aspalathus linearis* natural extract *Ribooos tea* is reported in this contribution. Crystallinity of Tetragonal perovskite  $\text{Cu}_{0.3}\text{Zn}_{0.7}\text{SnO}_3$  nanoparticles at room temperature and annealed at 300 and 600°C was investigated by X ray diffraction. High resolution transmission electron microscope (HRTEM) and high resolution scanning electron microscope (HRSEM) were used for determination of morphology, confirmed the nanoclusters of  $\text{Cu}_{0.3}\text{Zn}_{0.7}\text{SnO}_3$  annealed at 500°C. Characterization of material was carried out using XRD , UV-VISIBLE, FTIR tools. The uniform distributed single phase nanoparticles were found using structure characterization tools for no impurity.

**SYNTHESIS AND CHARACTERIZATION OF  
COPPER DOPED MELAMINIUM PHTHALATE  
SINGLE CRYSTALS**

Project report submitted to the University of Kerala

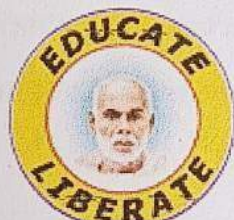
In partial fulfilment of the requirements for the award of the Degree of

**MASTER OF SCIENCE  
IN PHYSICS**

*By*

Nandu Mohan

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**Department of Physics**

**SREE NARAYANA COLLEGE**

Chengannur

2020-21





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## CERTIFICATE

This is to certify that the dissertation entitled "**SYNTHESIS AND CHARACTERIZATION OF COPPER DOPED MELAMINIUM PHTHALATE SINGLE CRYSTALS**" submitted to the **University of Kerala** in partial fulfilment of the requirement for the award of the degree of **MASTER OF SCIENCE IN PHYSICS** is a record of original research work done by **NANDU MOHAN** during the period 2020-2021, under my guidance at St. Gregorios College, Kottarakkara.

Dr. Indulal. C R

## ABSTRACT

Solids are one of the four fundamental states of matter. In solids, the particles are arranged in a definite manner so that they have a regular shape. Solids are mainly classified as crystalline solids and amorphous solids. Many studies are developing in the field of solids. In this project we are discussing about crystalline solids. Crystalline solids have use in many areas of developments. The word 'crystal' comes from a Greek word which means clear ice. Crystals are used in many fields of day-to-day life such as industrial, medicine, agriculture, research, household, etc. In the area of medicine, a primitive type of healing is done with the help of many crystals such as quartz, agate, amethyst or opals.

In this project we prepared single crystals of copper doped melaminium phthalate. Single crystals of copper doped melaminium phthalate were grown from aqueous solution by slow solvent evaporation method at room temperature. X-ray powder diffraction analysis confirmed that the copper doped melaminium phthalate crystallizes in orthorhombic system. UV spectroscopy studies of copper doped melaminium phthalate crystal were done. The direct optical bandgap value of copper doped melaminium phthalate powder crystal was found to be 2.64eV.

# STUDIES ON SPECIFIC ABSORPTION RATE OF CELLULAR TOWERS RADIATION

Dissertation

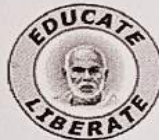
Submitted to University of Kerala, Trivandrum

*In partial fulfillment of the requirements for the award of the Degree of Masters of  
science in Physics*

Submitted by:

**SHEKHA G**

**(REG NO:63019128014)**



**SREE NARAYANA COLLEGE CHENGANNUR**

Under the guidance of

**Dr. P.J.JOJO**

**DEPARTMENT OF PHYSICS**



**FATIMA MATA NATIONAL COLLEGE (AUTONOMOUS)**

**KOLLAM**

**2019-2021**



DEPARTMENT OF PHYSICS  
FATIMA MATA NATIONAL COLLEGE, KOLLAM



Dr.P.J.Jojo  
Associate professor  
Department of physics  
Fatima Mata National college,kollam  
jojopanakal@gmail.com

CERTIFICATE

This is to certify that Ms.SHEKHA.G;Sree Narayana college, chengannur,kerala university carried out her M.Sc project work on the topic "STUDIES ON SPECIFIC ABSORPTION RATE OF CELLULAR TOWERS RADIATION" under my guidance of department of physics, FATIMA MATA NATIONAL COLLEGE ,Kollam.

**Dr Jojo P.J.**  
**Principal**  
Fatima Mata National College (Autonomous)  
Kollam - 691001, Kerala, India  
jojopanakal@gmail.com



## **ABSTRACT**

This project was mainly intended to study the effects of electromagnetic radiation from cellular towers in various regions of Kollam district in Kerala. According to Studies and as per the International Commission on non-ionizing radiation , it is found that mobile radiation are within safe limits. This report presents an account of the study we conducted on the fields of radiation cellular towers in Kollam district, Kerala . This project maybe regarded as the primary attempt to study biological and thermal effects due to mobile radiation .From the obtained data, it is observed that eye gets maximum exposure followed by blood tissue and so on, also higher SAR does not lead to enhanced biological response.

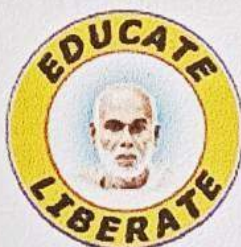
# **BAND STRUCTURE AND DENSITY OF STATES STUDIES OF GRAPHENE AND GRAPHITE USING DENSITY FUNCTIONAL THEORY**

**Project report submitted to the University of Kerala in the partial  
fulfilment of the requirement of the Degree of MASTER OF SCIENCE  
IN PHYSICS**

Submitted by

**SARANGI KRISHNA K**

**Reg. No:63019128013**



**DEPARTMENT OF PHYSICS  
SREE NARAYANA COLLEGE  
CHENGANNUR, ALAPPUZHA**

**2019-2021**

## CERTIFICATE

This is to certify that the project "BAND STRUCTURE AND DENSITY OF STATES STUDIES OF GRAPHENE AND GRAPHITE USING DENSITY FUNCTIONAL THEORY" is done by Sarangi Krishna K under my guidance towards the partial fulfilment for the award of Master of Science Degree in Physics from the University of Kerala for the academic year 2019-2021.



**ARYA B**

**Assistant Professor**

**University college, TVPM**



## ABSTRACT

In order to find and study about materials with suitable electrical properties, a wide range of theoretical and experimental methods are used. The most commonly used method for theoretical calculations is density functional theory (DFT). It is a method where the electronic structure is described as a functional of the electronic density. There are a number of different numerical implementations of DFT using different approximations. In this project, DFT using plane waves and pseudopotential approximations is used. This project has been carried out using the Quantum Espresso software with pseudopotentials. Using Quantum Espresso, band structures and density of states of two types of materials are calculated; graphene as a 2D system and graphite as a 3D system. It reflects the fact that the graphite allotrope of carbon consists of stacked graphene layers. The band structures obtained are then compared to experimental results to see if the pseudopotentials manage to accurately describe the characteristics of the real band structures.

In the first two chapters of this report, a background to the theory used in this thesis is described, giving a more detailed explanation of basic solid state physics and density functional theory. Chapter one includes discussion on crystal lattices, reciprocal lattice, Bloch's theorem, Fermi energy, Band structure, Spin Orbit Coupling and density of states. The correlated many body problem, Density Functional theory, the Kohenberg-Kohn theorems, the Kohn-sham potential, the exchange correlation functional, plane wave basic set and pseudopotential methods are discussed in chapter 2. In the third chapter, the methods used for the calculations are explained. Calculations carried out for the sample systems are also included in this chapter. Lastly, the result from the band structure and density of states calculations are presented and discussed.

The conclusion, limitation and scope of the work are included in the last session.

**EFFECT OF NICKEL SUBSTITUTION ON THE ABSORPTION  
CHARACTERISTICS OF MANGANESE TUNGSTATE  
SYNTHESIZED VIA CITRATE-GEL METHOD**

Dissertation

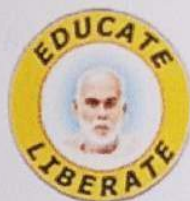
Submitted to the University of Kerala, Trivandrum

*In Partial fulfilment of the requirements for the award of the degree of  
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By

SREELEKSHMI A

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Under the Supervision

of

Dr. MAHESH S K

(Assistant Professor, N S S College Pandalam )



JULY 2021





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Assistant professor  
P G Dept. of Physics  
NSS College, Pandalam

### CERTIFICATE

This is to certify that this project report entitled “**EFFECT OF NICKEL SUSTITUTION ON THE ABSORPTION CHARACTERISTICS OF MANGANESE TUNGSTATE SYNTHESISED VIA CITRATE-GEL METHOD**” submitted to University of Kerala in partial fulfilment of the requirement for the award of the **DEGREE OF MASTER SCIENCE IN PHYSICS** is a bonafide record of the project work done by **SREELEKSHMI A** during the period February 2021 to July 2021, under my guidance at NSS College, Pandalam.

Dr Mahesh S K

## ABSTRACT

There is a strong incentive to develop new colorants based on inorganic materials to substitute for industrial pigments that are based on toxic metals hazardous to health and the environment. Yellow is particularly important color in the industrial pigment field and there is a serious need to search for environmentally friendly and economically viable materials for the replacement of toxic inorganic pigments. The colour of the  $\text{MnWO}_4$  pigment can be turned by introducing other elements into  $\text{MnWO}_4$ . In the present study,  $\text{Mn}_{1-x}\text{Ni}_x\text{WO}_4$  pigments have been synthesized by citrate-gel method. Doping of Nickel into the lattice gently changes the yellow color of the pigment. The structure and optical properties were studied using powder X-Ray diffraction technique. The UV-Visible absorption spectra direct and band gap nature of the prepared sample. The  $\text{NiWO}_4$  has high band gap energy compared to  $\text{MnWO}_4$  pigments.

**EFFECT OF ALUMINIUM SUBSTITUTION ON THE  
OPTICAL PROPERTIES OF PRASEODYMIUM MOLYBDATE  
YELLOW PIGMENTS**

Dissertation

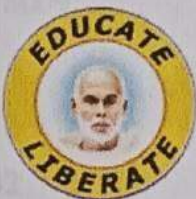
Submitted to the University of Kerala, Trivandrum

*In Partial fulfilment of the requirements for the award of the degree of  
Masters of Science in Physics*

By

**MRIDU R MURALI**

(CANDIDATE CODE : 63019128009)



**SREE NARAYANA COLLEGE, CHENGANNUR**

Under the Supervision

of

**Dr. MAHESH S K**

(Assistant Professor, N S S College Pandalam )



**JULY 2021**






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Assistant Professor  
P G Dept. of Physics  
NSS College, Pandalam

### CERTIFICATE

This is to certify that this project report entitled "**EFFECT OF ALUMINUM SUBSTITUTION ON THE OPTICAL PROPERTIES OF PRASEODYMIUM MOLYBDATE YELLOW PIGMENTS**" submitted to University of Kerala in partial fulfilment of the requirement for the award of the **DEGREE OF MASTER SCIENCE IN PHYSICS** is a bonafide record of the project work done by **MRIDU R MURALI** during the period February 2021 to July 2021, under my guidance at NSS College, Pandalam.

  
Dr Mahesh S K



## ABSTRACT

There is a strong incentive to develop new colorants based on inorganic materials to substitute for industrial pigments that are based on toxic metals hazardous to health and the environment. Yellow is particularly important color in the industrial pigment field and there is a serious need to search for environmentally friendly and economically viable materials for the replacement of toxic inorganic pigments. Molybdates are widely studied due to the high technological interest related to their important physical and chemical properties. In the present study, Aluminium doped  $\text{Pr}_2\text{MoO}_6$  yellow pigments have been synthesized by citrate-gel method. Doping of aluminium into the praseodymium matrix gently changes the color of the pigment from yellow to green. The nature and structural variation were studied using X-Ray diffraction technique. The physical - optical properties & band gap were studied using UV-Visible reflection & absorption spectra. The change of color has been attributed to the substitution of the praseodymium ions by the trivalent aluminum ions creating oxide ion vacancies and this defect formation is responsible for change in band gap.

**Anthropic Principle and Large Number Hypothesis**

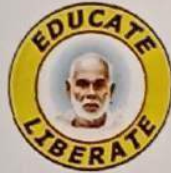
**Dissertation**

**Submitted by University of Kerala, Trivandrum**

*In partial fulfillment of the requirements for the award of the degree of  
Master of Science*

By

**ANGIRAS N NAMBOOTHIRI**



**SREE NARAYANA COLLEGE**

**CHENGANNUR**

Under the supervision

Of

**Dr. Narayanankutty Karuppath**

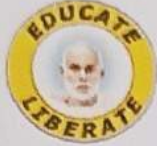
Professor and Chair PGP

Department of Physics

Amrita School of Arts and Sciences

Amritapuri, AVVP

**August 2021**



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2021

### CERTIFICATE

This is to certify that the dissertation entitled “**Anthropic Principle and Large Number Hypothesis**” is an authentic record of the project carried out by **Mr. Angiras N Namboothiri** in partial fulfillment of the requirements for the award of Master of Science in Physics.

*Sreelatha K*

**Dr. K Sreelatha**

Head of the Department of Physics  
Sree Narayana College, Chengannur

## ABSTRACT

In cosmology, the Anthropic Principle deals with the values of natural constants and the laws of nature. According to Anthropic Principle the constants of nature assume their values for the existence of life. This means that the constants are nature assuming their values not as a mere coincidence. Some evidence in nature shows that the ratios of some large numbers are of certain powers of ten. Anthropic principle is a philosophical explanation for the existence of life on earth. The value of age of the earth, the temperature of the earth, the position of the earth, the electromagnetic force between the elementary particles, etc. are not just a coincidence. They are the only values that can be possessed for the sustainability of life. Or else we have to say that life is adaptive.

The Large Number Hypothesis by Paul Dirac deals with the ratios of very large dimensionless numbers and it is found to be ten to the power of thirty nine. He also said that the similarity is these ratios are not a mere coincidence. Hence we can introduce the Anthropic Principle for providing a philosophical argument and mathematical proof for Dirac's hypothesis. His other assumption was that these large numbers vary with the age of the universe. This hypothesis was also revised by saying that these large number parameters are functions of deceleration parameters.



STRUCTURAL AND OPTICAL STUDIES OF  
COBALT ALUMINATE NANOPARTICLES

PROJECT REPORT

Submitted by

AMEENA MAJEED

Reg. No. 63019128002

*In the partial fulfilment for the award of the Degree of*

MASTER OF SCIENCE

In

PHYSICS

*of*

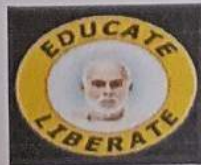
UNIVERSITY OF KERALA



DEPARTMENT OF PHYSICS

S N COLLEGE, CHENGANNUR

(Affiliated to University of Kerala)



Chengannur -689508

July-2021

DEPARTMENT OF PHYSICS

Sree narayana college, kollam



Dr. Dedhila Devadathan

Research guide & assistant professor

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Devabhavanam  
Residency Nagar 5  
Kollam 691001

CERTIFICATE

This is to certify that Mrs Ameena Majeed .,Sree narayana college, chengannur, kerala university carried out her M. Sc project work on the topic “**structural and optical studies of cobalt aluminate nanoparticles** “ under my guidance at department of physics, Sree narayana college, kollam

*Dedhila*  
Dr. DEDHILA DEVADATHAN  
Assistant Professor, Department of Physics  
Sree Narayana College, Kollam - 691 001  
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Mob: 9446454083

## ABSTRACT

Nanoscience is an interdisciplinary field that seeks to bring about mature nanotechnology, focusing on the nanoscale intersection of fields such as physics, engineering, chemistry, computer science, mechanics, materials science, electronics, biology, medicine and more. Chapter 1 is dealing with introduction to nanoscience as well as the aim of the present study.

In chapter 2 a brief description on the experimental technique used for the synthesis of metal oxide nanoparticles cobalt aluminate nanoparticles at different temperatures are discussed.

The chapter 3 describes all the structural and optical characterization techniques carried out for the nanoparticles. The structural characterizations of the synthesized samples were carried out using FTIR and XRD. The optical characterizations of the nanoparticles were done using UV-Vis spectroscopy.

The work is focussed on the effect of annealing on the characterizations of cobalt aluminate nanoparticles. But from XRD it can be concluded that the formed system is a nanocomposite or a heterostructure of cobalt oxide and cobalt aluminates. The optical characterizations done for nanoparticles at different temperatures showed the materials have multiple band gaps. Detailed structural and optical analysis of these samples are given in chapter 4. Importance have been given for the variations observed in formed samples with annealing temperature.

The project work is concluded with the summary and future scope of the work in chapter 5 followed by references.



# **“PLASMONIC INTERACTIONS IN NANOSYSTEMS”**

**Dissertation**

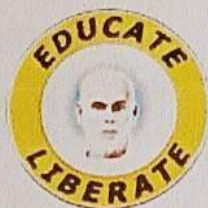
**Submitted to the University of Kerala, Trivandrum**

*In Partial fulfilment of the requirements for the award of the degree of  
Masters of Science in Physics*

**By**

**ANU PRAKASH ACHARI**

**(CANDIDATE CODE : 63019128004)**



**SREE NARAYANA COLLEGE, CHENGANNUR**

**Under the Supervision**

**of**

**Dr. VINOY THOMAS**

**(Assistant Professor, Christian college, Chengannur )**



**JULY 2021**





## Post Graduate Department of Physics

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Chengannur-689122

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**Dr. Vinoy Thomas**

Assistant professor

Research Guide, Kerala University

---

### CERTIFICATE

This is to Certify that **Mr. Anu Prakash Achari** M.Sc. Student from Sree Narayana College, Chengannur, Kerala University carried out his project work on the topic "**PLASMONIC INTERACTIONS IN NANOSYSTEMS**" Under my guidance at Department of Physics, Christian College, Chengannur.

**VINOY THOMAS M.Sc., Ph.D**  
Assistant Professor  
Department of Physics  
Christian College, Chengannur.

## ABSTRACT

An investigation of surface plasmon resonance (SPR) of green synthesized silver nanoparticles is given in this thesis. The absorption of light by metal nanoparticles is dominated by the surface plasmon (SP) resonance. In small particles, the strong three-dimensional confinement changes both the static and dynamic optical properties. The surface plasmon resonance of silver nanoparticles was observed in the wavelength range 350-430nm. An effort has been made to study the Surface plasmon mediated excitation energy transfer (EET) between two spherical metal nanoparticles. Also we have made an attempt to calculate van der Waals (vdW) energy and Casimir energy between plasmonic silver nano particles in the present matrix as the energy of vacuum fluctuations of plasmonic modes existing in present system.

# **“SYNTHESIS OF ANISOTROPIC NANO MATERIALS AND EVALUATION OF BAND GAPS”**

**Dissertation**

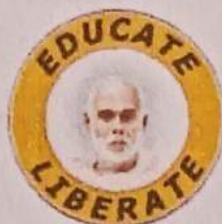
**Submitted to the University of Kerala, Trivandrum**

*In Partial fulfilment of the requirements for the award of the degree of  
Masters of Science in Physics*

**By**

**HARKISHAL S**

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**JULY 2021**





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### CERTIFICATE

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VINOY THOMAS M.Sc., Ph.D  
Assistant Professor  
Department of Physics  
Christian College, Chengannur.



## **ABSTRACT**

Bio inspired synthesis of metal nanoparticles is evolving into an important branch of nanotechnology. Anisotropic nanoparticles are ideal building blocks for a number of functional materials due to their exceptional and anisotropic optical, electronic, magnetic and mechanical properties. This thesis presents the biosynthesis of silver nanoparticles using hydrogen peroxide as reducing and citrate as stabilizing agent. The synthesized nanoparticles are characterized using UV-Visible, and optical band gap. In the present case,  $H_2O_2$  acts as an oxidant from the very beginning of the reaction. We also found that particle morphology strongly affects the SPR peaks. The band gap of each plasmonic system was evaluated and tabulated.

# STRUCTURAL AND OPTICAL ANALYSIS OF COPPER ALUMINATE NANOPARTICLES

Dissertation

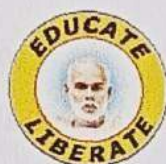
Submitted to University of Kerala, Trivandrum

*In partial fulfillment of the requirements for the award of the Degree of Masters of science in Physics*

By

NEETHU S

(REG NO:63019128011)



SREE NARAYANA COLLEGE CHENGANNUR

Under the supervision

Of

Dr.Dedhila Devadathan

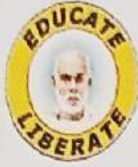
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Sree Narayana college, Kollam

August 2021



Sree narayana college  
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2021

### CERTIFICATE

This is to certify that the dissertation entitled “**Structural and optical studies of copper aluminate nanoparticles**” is an authentic record of the project carried out by **Ms.Neethu S** in partial fulfillment of the requirement for the award of Master of Science in Physics.

Dr. K Sreelatha

Head of the department of Physics  
Sree narayana college, chengannur

Dr. K. SREELATHA  
Assistant Professor & Head  
Department of Physics  
Sree Narayana College  
Chengannur - 689508



## ABSTRACT

Nanoscience is a developing research area which has seen a burst of scientific and industrial interest over the last few years. The chapter 1 deals with an introduction to nanomaterials. In addition, the chapter discusses the aim of the present work.

In chapter 2 a brief description on the experimental technique used for the synthesis of metal oxide nanoparticles copper aluminate nanoparticles at different temperatures (500°C and 700°C) are discussed.

The chapter 3 describes all the structural and optical characterization techniques carried out for the nanoparticles. The structural characterizations of the synthesized samples were carried out using FTIR and XRD. The optical characterizations of the nanoparticles were done using UV-Vis spectroscopy.

The work is focussed on the effect of annealing on the characterizations of copper aluminate nanoparticles. But from XRD it can be concluded that the formed system is a nanocomposite or a heterostructure of copper oxide and copper aluminates. The results obtained for the structural confirmed the formation of  $\text{CuAl}_2\text{O}_4/\text{CuO}$  nanoparticles. The optical characterizations done for  $\text{CuAl}_2\text{O}_4/\text{CuO}$  nanoparticles at different temperatures showed the materials have multiple band gaps. Detailed structural and optical analysis of these samples are given in chapter 4.

In the present world there is a pressing demand to develop new antimicrobial agents and discover novel strategies due to the emerging infectious diseases. The chapter 5 presents the antibacterial studies of synthesized nanoparticles. The present study investigates the antimicrobial activity of the synthesized samples. The gram positive bacteria: *Bacillus cereus*, the gram negative bacteria: *Escherichia Coli* are the microbes used in the present study. The project work is concluded with the summary and future scope of the work in chapter 6 followed by references.



# **SYNTHESIS, CHARACTERISATION AND OPTICAL STUDIES OF ZnSnO<sub>3</sub> NANOPARTICLES USING ROOIBOS TEA NATURAL EXTRACTS**

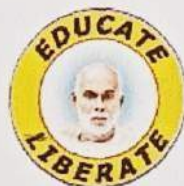
*A project report submitted to the University of Kerala For the partial  
fulfillment of the Requirements for the Degree of*

**MASTER OF SCIENCE  
IN PHYSICS**

**By**

**PRIYANKA .P**

**Reg. No 63019128012**



**SREE NARAYANA COLLEGE**

**CHENGANNUR**

**UNIVERSITY OF KERALA**

*Under the guidance of*

**ARUN. S. PRASAD**

**ASSISSTANT PROFESSOR**

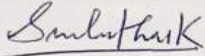
**DEPARTMENT OF PHYSICS**

**T.K.M.M COLLEGE NANGIARKULANGARA**

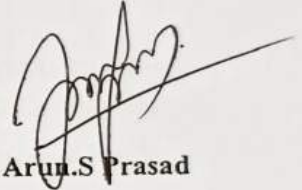
**2019 – 2021**

## CERTIFICATE

This is to certify that this project report entitled "SYNTHESIS , CHARACTERISATION AND OPTICAL STUDIES OF  $ZnSnO_3$  NANOPARTICLES USING ROOIBOS TEA NATURAL EXTRACTS" is a bona-fide record of the work done by **PRIYANKA P** under my guidance and supervision in partial fulfillment of the requirement for the award of the Degree of Master of Science in Physics, from Kerala University. It is further certified that no part of this work has been presented for the award of any other Degree or Diploma by any other university or Institution.



**Dr. SREELATHA K**  
Head of the Department



**Dr. Arun.S Prasad**  
Assistant Professor  
Supervising Guide

### Examiners

- 1.
- 2.

**Chengannur**

**Date:**

## ABSTRACT

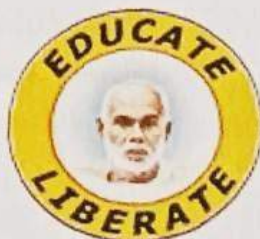
The biosynthesis of ZnSnO<sub>3</sub> nanoparticle via *Aspalathus Linearis* natural extract is reported in this contribution . *Aspalathus Linearis* is a broom like member of the fabaceae family of plants commonly known as rooibas , grows naturally in the cederberg area the western cape province of South Africa and is known for its commercial use as herbal tea . In the present research work we have extracted *Aspalathus Linearis* from green tea through several steps which fall into several categories : material treatments , extraction of tea , isolation and finally drying of tea leaves .

Crystallinity of perovskite ZnSnO<sub>3</sub> nanoparticles at room temperature and was investigated by Xray diffraction . Characterization of the material was carried out using XRO,UV,FTIR, tools also. The uniform distributed single phase nanoparticles were found using structures characterization tools for no impurities . Nanoparticles are recently utilized in electrochemical purpose of alcohols, gases ,acetone, H<sub>2</sub>O<sub>2</sub>, and neurotransmitters exhibiting good selectivity ,sensitivity, ,excellent reproducibility, and anti-inference ability . Moreover they have been utilized as catalyst in oxygen reduction and hydrogen evolution reaction.

**SYNTHESIS AND CHARACTERIZATION OF CERIUM  
OXIDE AND COPPER DOPED CERIUM OXIDE  
NANOPARTICLES**

Project report submitted to the University of Kerala in partial fulfilment  
of requirement for degree of Masters of Science in Physics

**DEPARTMENT OF PHYSICS  
SREENARAYANA COLLEGE  
CHENGANNUR**



SUBMITTED BY

**VIJESH VIJAYAN**

**REG.NO.63019128019**

**UNDER THE SUPERVISORIN OF**

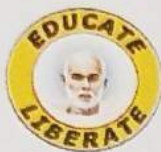
**SHRI.HAREESH P.S**

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**NSS COLLEGE PANDALAM**

**2020-21**





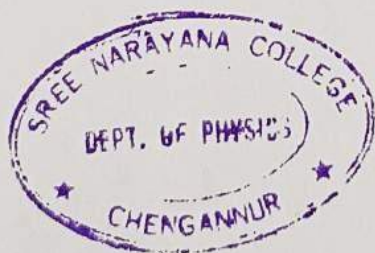
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Phone: 0479-2360140

2021

## CERTIFICATE

This is to certify that the dissertation entitled '**Synthesis and characterization of cerium oxide nanoparticles and copper doped cerium oxide nanoparticle**' is an authentic record of the project carried out by **Mr. Vijesh Vijayan** in partial fulfillment of the requirements for the award of Master of Science in Physics.



**Dr. K Sreelatha**

Head of the Department of Physics  
Sree Narayana College, Chengannur

Dr. K. SREELATHA  
Assistant Professor & Head  
Department of Physics  
Sree Narayana College  
Chengannur - 689508

## ABSTRACT

Nanoparticles of rare earth oxides, in particular, cerium oxide, has been extensively studied due to its commercial applications as a catalyst, oxygen sensor, solid electrolyte, and absorbent, among others. It is well known that rare earth oxides were used as catalysts in a wide variety of reactions of industrial and environmental interest. These oxides has a high oxygen mobility and storage capacity, and can act as a local source or sink for oxygen involved in reactions taking place on its surface. In the present work, nanoparticles of ceria were synthesized using chemical precipitation technique using Cerium (III) nitrate hexa hydrate and Sodium hydroxide as precussers. The nanoparticles of Cerium oxide were also synthesized using tri Ethanol Ammine (TEA) as the surfactant. The XRD pattern of nanoparticles of ceria were recorded. From the XRD pattern it was observed that ceria nanoparticles of present study are in cubic phase. The grain size of the particles calculated from XRD pattern is about 10nm. The band gap of nanoparticles of ceria calculated from UV- visible spectrum absorption is about 4.95eV. It is found that there is an increase in band gap as compared with bulk material. The photoluminescence spectra was also recorded. The emission peak was observed at 404nm and is less compared to the band gap of ceria. The emission peak can be attributed to radiative transitions between defects levels due to oxygen vacancies

Nanoparticles of copper doped cerium oxide was also prepared by chemical precipitation method. XRD, UV Visible analysis was also done. It was observed that the band gap decreased with increase in concentration of Cu.

**Effect of Potassium Substitution on the Properties  
of LAMOX Fast Oxide Ion Conductor**

*Project Report submitted to*

**University of Kerala**

*In partial fulfillment for the award of the degree of*

**MASTER OF SCIENCE**

**in Physics**

By

**MANJU S**

(Reg: No. 63019128008)

*Under the guidance of*

**Dr. Sib K S**

Department of Physics

Kariavattom Campus

University of Kerala

Thiruvananthapuram – 695581

2021



DEPARTMENT OF PHYSICS  
UNIVERSITY OF KERALA  
KARIAVATTOM CAMPUS, TRIVANDRUM 695581

Dr. Sibi K S

Head of the Department

**CERTIFICATE**

This is to certify that work embodied in the project report entitled, “**Effect of Potassium Substitution on the Properties of LAMOX Fast Oxide Ion Conductor**” has been carried out by **Ms. Manju S** under my supervision and guidance at Department of Physics, University of Kerala.

Kariavattom

03-05-2021



Dr. Sibi K S



## **Preface**

The hike in price of petroleum products and gradual increase in pollution due to the dependence on conventional energy source is a major issue that our world facing today. It is important to introduce an efficient alternative energy source to solve this problem. Solid oxide fuel cell is an efficient alternative source of energy which is also environment friendly. It is in an underdeveloped state due to some problems affecting them on different stages of developments in electrolytes, electrodes, interconnectors etc. IN the case of electrolytes, the major problems are high operating temperature, high electrolyte resistivity etc. Different types of ceramic materials have been tested and used as oxide ion conductors for the proper development of solid oxide fuel cells. LAMOX was such a novel material to this family, which gathered the attention of current research in this discipline.  $\text{La}_2\text{Mo}_2\text{O}_9$  undergoes a structural transition from a low temperature slightly distorted form (alpha-monoclinic) to a high temperature more conducting form (beta-cubic). But the phase transitions cause some drastic drop in its conductivity. Large number of substitutions are possible to suppress the phase transition and stabilise the cubic form at room temperature.

The present work focused on effect of potassium substitution in LAMOX. This work aims to have a detailed structural study of LAMOX family through solid state reaction method. After synthesising  $\text{K}_x\text{La}_{2-x}\text{Mo}_2\text{O}_{9-\delta}$  ( $x=0.0,0.05$ ), the characterisation works are carried out such as X-ray powder diffraction method, Diffuse reflectance method using UV Visible radiation, Photoluminescence spectroscopy, FTIR and Raman spectroscopy. The X-ray diffraction patterns obtained are analysed using DIFFRAC SUITE EVA and TOPAS 4.2 software. PL studies are carried out to check the luminescence character and band gap energy is determined using UV Visible spectrum. FTIR spectroscopy and Raman spectroscopy are used for the structural investigation.

**"COLORIMETRIC SENSING OF HYDROGEN  
PEROXIDE USING SILVER NANOPARTICLES"**

Dissertation

Submitted to the University of Kerala, Trivandrum

In Partial fulfilment of the requirements for the award of the degree  
of Master of Science in Physics

By

LEKSHMI U.

(CANDIDATE CODE: 63019128007)



SREE NARAYANA COLLEGE, CHENGANNUR

Under the Supervision

of

Dr. VINOY THOMAS

(Assistant Professor, Christian college, Chengannur)



JULY 2021



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Research Guide, Kerala University

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### CERTIFICATE

This is to Certify that **Ms. Lekshmi U.** M.Sc. Student from Sree Narayana College, Chengannur, Kerala University carried out her project work on the topic "**COLORIMETRIC SENSING OF HYDROGEN PEROXIDE USING SILVER NANOPARTICLES**" Under my guidance at Department of Physics, Christian College, Chengannur.

VINOY THOMAS M.Sc., Ph.D  
Assistant Professor  
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Christian College, Chengannur.

## ABSTRACT

Nanomaterials are particles whose dimension lies within the range of 1 nm to 100 nm. In the nanoscale level, many properties get modified when compared to molecular level. Silver nanoparticles have unique optical, electrical and thermal properties ranging from photovoltaics to biological and chemical sensors.

Hydrogen peroxide is a reactive oxygen species present in the human body which controls a lot of biological processes.

In this work silver nanoparticles were synthesised by chemical reduction using tri sodium citrate. The solution will be of golden yellow colour after about 15 minutes of preparation, indicating the formation of silver nanoparticles. These citrate stabilized silver nanoparticles are synthesized and characterized by UV-Vis Spectroscopy, TEM, FTIR methods. Using these, a spectroscopy method has been developed for determination of hydrogen peroxide. The rapid colour change of the solution from milky white to colourless indicate that the solution can act as colorimetric sensor. Therefore, the colorimetric hydrogen peroxide sensor has great applications in bio medical research as sensors.



**“RAPID SYNTHESIS OF SILVER NANO PARTICLES  
FOR FLUORESCENT QUENCHING”**

**Dissertation**

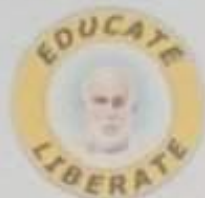
**Submitted to the University of Kerala, Trivandrum**

*In Partial fulfilment of the requirements for the award of the degree of  
Masters of Science in Physics*

**By**

**SURAJ S NAIR**

**(CANDIDATE CODE : 63019128018)**



**SREE NARAYANA COLLEGE, CHENGANNUR**

**Under the Supervision**

**of**

**Dr. VINOY THOMAS**

**(Assistant Professor, Christian college, Chengannur )**



**JULY 2021**



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### CERTIFICATE

This is to Certify that **Mr. Suraj S Nair M.Sc.** Student from Sree Narayana College, Chengannur, Kerala University carried out his project work on the topic "**RAPID SYNTHESIS OF SILVER NANO PARTICLES FOR FLUORESCENT QUENCHING**" Under my guidance at Department of Physics, Christian College, Chengannur.

**VINOY THOMAS M.Sc., Ph.D**  
Assistant Professor  
Department of Physics  
Christian College, Chengannur.

## ABSTRACT

In recent years Nano Science and Technology has received tremendous attention in research Fields. The development of new economically feasible methods for the production of metal nano particles have introduced pilot scale production of metal nano particles, that have gained market in various consumer products. The most important feature of nano particles are their surface area to volume ratio, where it easily allows them to interact with other particles. The main advantage of metal nano particles is that, they enhance Rayleigh and Raman scattering.

The silver nano particles are one of the most attractive inorganic materials because of it's environment free nature. Moreover, it has several applications in various fields like, photography, diagnostics, catalysis, biosensor, anti-microbial etc.

This Project aims the synthesis and characterization of silver nano particles. Here we employ the green synthesis, the eco-Friendly method for its extraction from green tea leaves. Hence, by UV spectroscopy and fluorescence spectroscopy, we characterize the nature and features of silver nano particles. From that we find it's optical properties for fluorescent quenching. This finding has a remarkable importance in the field of Nano-technology.

2018-2020

**Dr. Dedhila Devadathan**

Assistant Professor  
Department of Physics  
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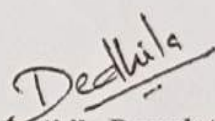
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## Certificate

This is to certify that the work embodied in the thesis entitled “**structural, optical, photocatalytic studies of copper oxide nano particles synthesized from combustion method**” has been carried out by **Nithina S** under my supervision and Guidance.

Kollam

June 2020

  
Dr. Dedhila Devadathan

(Project Guide)

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Assistant Professor, Department of Physics  
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## ABSTRACT

CuO is a metal oxide nanoparticle having a variety of chemical and physical properties, is recently attractive in many fields such as energy conversion, optoelectronic and catalyst. In the present study CuO was synthesized using solution combustion method, this method involves propagation of self-sustained exothermic reaction along an aqueous or sol gel media. The CuO nanoparticles synthesized was characterized using X-ray Diffraction Spectroscopy (XRD). X-ray diffraction is an ideal technique for the determination of crystallite size of the powder samples. The structural studies using XRD characterization confirmed that the sample synthesized were CuO and crystallinity of sample were confirmed. The optical studies were done using UV characterization method. The sample showed strong UV as well as, visible absorption. Hence the material is suitable for anti UV applications. The present study showed very good photocatalytic activity. The results suggest that these materials could be efficiently used as antibacterial, anti-fogging and surface purification agent.

**SYNTHESIS AND CHARACTERIZATION OF TiO<sub>2</sub>-ZrO<sub>2</sub>  
THIN FILM FOR PHOTOCATALYTIC APPLICATIONS**

Project Report

Submitted to the University of Kerala

In partial fulfillment of the requirements for the award of the degree of

Master of Science in Physics

By

**AKSHAY A**

**(REG NO: 63018128001)**



**SREE NARAYANA COLLEGE, CHENGANNUR**

*Under the supervision*

*Of*

**Dr. N V Unnikrishnan**

**Visiting Professor**



**School of Pure and Applied Physics**

**Mahatma Gandhi University Kottayam-686560**

**April 2020**

## CERTIFICATE

This is to certify that the project dissertation entitled “**SYNTHESIS AND CHARACTERIZATION OF TiO<sub>2</sub>-ZrO<sub>2</sub> THIN FILM FOR PHOTOCATALYTIC APPLICATIONS**” is the bonafide record of work done by **Akshay A** (Candidate code: 63018128001), M.Sc. Fourth Semester, Department of Physics, **Sree Narayana College, Chengannur** in the partial fulfillment of requirements for the award of Degree of Master of science in Physics from University of Kerala, Thiruvananthapuram.

**Dr. K Sreelatha**

(Head of the Department)

External Examiners:

- 1.
- 2.

## ABSTRACT

Development of thick superhydrophilic  $\text{TiO}_2\text{-ZrO}_2$  transparent coatings realized through the inclusion of poly(methyl methacrylate) and Pluronic-F127 with excellent self-cleaning properties and high transmittance has been developed on glass substrates using a simple dip-coating technique. The formation of the composites, successful incorporation of the polymer into the matrix, and the porous nature of the films have been studied. The prepared samples are found to exhibit excellent self-cleaning properties, which can be substantially retained for hours. The excess amount of hydroxyl groups present in  $\text{TiO}_2\text{-ZrO}_2$  hybrid composites trap photo-induced holes, which increase the photocatalytic activity by delaying the recombination of electron-hole pairs. This implies that such a coating would be able to breakdown the dirt absorbed onto its surface in the presence of sunlight. The hydroxyl group-trapping ability of  $\text{TiO}_2\text{-ZrO}_2$  along with high porosity of polymer-incorporated composites can be combined together in  $\text{TiO}_2\text{-ZrO}_2$  polymer coatings. Thin films of TZP and TZPP were prepared using dip coating method. For that, first of all a precursor dip coating solution was prepared and both films were deposited on glass substrates by the dip-coating technique (withdrawal rate 2 mm/s) followed by aging for 10 days at 50 °c. Single- and double-templated samples are designated as TZPF and TZPP, respectively. The dip-coating process was carried out using an ion exchanger dip-coating apparatus (Holmare model no. HO-TH-IE01) to prepare thin films TZPF and TZPPF.

Energy dispersive X-ray analysis attachment was used to carry out elemental analysis (EDS) and mapping of the samples. Field emission scanning electron microscopy (FESEM) was performed on gold coated samples using FEI Model: NOVA NANOSEM 450. Dye degradation study was



carried out using UV Visible spectrophotometer. The elemental map of Titanium (Ti) and Zirconium (Zr) in both TZPF and TZPPF are obtained by EDX attached with TEM. From the images it is very obvious that the elements titanium (Ti), and zirconium (Zr) are homogeneously distributed throughout the surface. A comparison of field emission scanning electron microscopy (FESEM) images clearly shows the formation of surface porosity in TZPPF, as well as in TZPF. For the photocatalytic active dye degradation studies, crystal violet (CV) is used. Crystal violet or gentian violet is a triarylmethane dye used as a histological stain and Gram's method of classifying bacteria. Crystal violet (CV) stock solution of 2.5mg/250ml was prepared. The films were dipped into the solution at a withdrawal speed of 2mm/s and allowed to dry for 5 minutes. Photocatalytic degradation was carried out by UV irradiation (365 nm). The degradation of CV deposited on the films was analyzed in absorbance mode within an interval of 15 minutes. UV light excites the microspheres by producing photoelectron-hole pairs. The enhanced porosity and more exposed  $\text{TiO}_2\text{-ZrO}_2$  nanodomains on the surface of TZPPF microspheres have certainly something to do with the improved photocatalytic degradation shown by them. Pores in the TZPPF microspheres act as channels to transmit incident photon flux to the inner region of the film which results in enhanced photodegradation of the dye trapped there. The high specific surface area exhibited by microsphere coatings allows a larger concentration of nanodomains on the coating surface which would also allow more dye molecules to be adsorbed onto the surface. All these factors aid TZPPF to exhibit excellent dye degradation capability. Photocatalytic property was observed for porous TZPPF film, which is more accessible to water and hence cleans out dirt quickly showing higher self-cleaning nature and Pluronic F127 also plays an important role in the roughened surface of the films which contributes to photocatalytic nature.

**Investigation on Structural and Optical Properties  
of K- Substituted  $\text{La}_2\text{Mo}_2\text{O}_9$**

*Project report submitted to*

**University of Kerala**

*In partial fulfillment for the award of the degree of*

**MASTER OF SCIENCE**

**in Physics**

By

**JESNY THANKACHAN**

(Reg: No. 63018128010)

**Sree Narayana College, Chengannur**

*Under the guidance of*

**Dr. Sibi K S**

Department of Physics

University of Kerala

Kariavattom Campus

Thiruvananthapuram – 695581

2018-2020



DEPARTMENT OF PHYSICS  
UNIVERSITY OF KERALA  
KARIAVATTOM CAMPUS, TRIVANDRUM 695581

Dr. Sibi K S

Head of the Department

### CERTIFICATE

This is to certify that the work embodied in the project report entitled, "Investigation on Structural and Optical Properties of K- Substituted  $\text{La}_2\text{Mo}_2\text{O}_9$ " has been carried out by Ms. Jesny Thanakachan under my supervision and guidance at Department of Physics, University of Kerala, Kariavattom.

Kariavattom

01.06.2020

Sibi K S

Head  
Department of Physics  
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## Abstract

Energy crisis arises due to growing population and depleting fossil fuels reserves all over the world. Most of the energy that we use at homes came from sun or electricity. Sun is the ultimate source of energy. It is limitless and abundant, but technologies to convert this energy into electrical or any other useful form have been inefficient. We mostly rely on traditional techniques for the production of energy such as thermal power plants that use coal and boilers and hydroelectricity that use water stored in dams. They are not sufficient to meet the growing demands.

Reducing the energy consumption level on an international scale is currently feasible, and a renewable alternative has yet to be successfully implemented, and some power source must be considered. One such source is the fuel cell. Fuel cells generate electricity by an electrochemical reaction in which oxygen and hydrogen-rich fuel combine to form water. German scientist G.H Shoenbein discovered fuel cell and it is first developed by William Grove in 1839, he demonstrated the direct conversion of chemical energy into electrical energy using a fuel cell. Francis Thomas Bacon, a British scientist, worked on developing alkaline fuel cells and he demonstrated a working stack in 1958. The technology was licensed to Pratt and Whitney where it was utilized for the Apollo space craft fuel cell.

In the present century, the most crucial threaten faced by our society is energy crisis. This arises due to increased population. The introduction of fossil fuel helps to overcome this crisis. Among the different type of fuel cell SOFC is most commonly used.

The present work includes the synthesis of oxide ion conducting compound LAMOX and K-substituted LAMOX by solid state reaction method. Here we add alkaline earth metal potassium to the LAMOX. The samples are prepared at different composition.



After synthesizing  $K_xLa_{2-x}Mo_2O_{9-\delta}$  ( $x = 0.0, 0.05, 0.1$ ), the prepared samples are characterized using various techniques like X-ray Diffraction, UV-Visible Spectroscopy and Photoluminescence Spectroscopy. X-ray diffraction pattern obtained are analyzed using DIFFRAC SUITE EVA and TOPAS 4.2 software. The X-ray diffraction pattern is determined by BRUKER D8 ADVANCE Diffractometer. UV-Visible Spectroscopy and Photoluminescence Spectroscopy are analyzed using JASCO V-750 UV-Visible spectrophotometer and Horiba Fluoromax 4 Spectrometer.

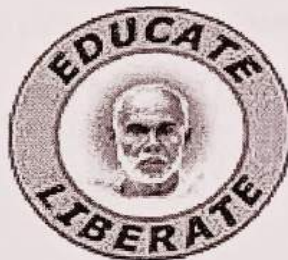
# **SYNTHESIS AND CHARACTERIZATION OF Cu DOPED CERIUM OXIDE NANOPARTICLE**

**A Dissertation submitted to the University of Kerala in  
partial fulfillment for the award of degree of**

**MASTER OF SCIENCE IN PHYSICS**

**By**

**ANJU KRISHNA**



**Candidate code : 63018128004**

**Course code : 630**

**Subject code : PH 201**

**Exam code : 63018401**

**Department of Physics  
SREE NARAYANA COLLEGE  
CHANGANNUR**

**2020**

## CERTIFICATE



This is to certify that the project report entitled "SYNTHESIS AND CHARACTERIZATION OF Cu DOPED CERIUM OXIDE NANOPARTICLE" submitted by ANJU KRISHNA in partial fulfilment of the requirement for the award of MSc degree in physics is a record of bonafide work done by her and the work has not been published in any journal or magazine.

**Dr. S. SARAVANA KUMAR**  
**HEAD OF THE DEPARTMENT**  
**DEPARTMENT OF PHYSICS**  
**N.S.S. COLLEGE**  
**PANDALAM**

**HAREESH . P S**  
**ASSOCIATE PROFESSOR**  
**DEPARTMENT OF PHYSICS**  
**N.S.S. COLLEGE**  
**PANDLAM**

## ABSTRACT

Nanoparticles of rare earth oxides, in particular, cerium oxide, has been extensively studied due to its commercial applications as a catalyst, oxygen sensor, solid electrolyte, and absorbent, among others. It is well known that rare earth oxides were used as catalysts in a wide variety of reactions of industrial and environmental interest. These oxides has a high oxygen mobility and storage capacity, and can act as a local source or sink for oxygen involved in reactions taking place on its surface. In the present work, nanoparticles of ceria & copper doped ceria were synthesized using chemical precipitation technique using Cerium (III) nitrate hexa hydrate and Sodium hydroxide and copper chloride as precussers. The nanoparticles of were also synthesized using tri Ethanol Ammine ( TEA ) as the surfactant. The calcinations temperature of cerium hydroxide was found from TG/DTA analysis. The XRD pattern of nanoparticles of ceria were recorded. From the XRD pattern it was observed that ceria nanoparticles of present study are in cubic phase. The grain size of the particles calculated from XRD pattern is about 5nm. The band gap of nanoparticles of ceria calculated from UV- visible spectrum absorption is about 5.42eV. It is found that there is an increase in band gap as compared with bulk material. Cu doped cerium oxide was synthesized using chemical precipitation method for different concentration and it's x-ray diffraction pattern was recorded and grain size was calculated . It was found that there is a decrease in grain size with doping. The UV- Visible spectrum is also recorded and the band gap energy was calculated for different concentration of Cu.



**NOVEL POLYMER BASED TiO<sub>2</sub>-ZrO<sub>2</sub> THIN FILM COATINGS  
WITH MULTIFUNCTIONAL APPLICATIONS**

Project Report

Submitted to the University of Kerala

In partial fulfillment of the requirements for the award of the degree of

Master of Science in Physics

By

**KAVYA SASIDHARAN K K**

**(REG NO: 63018128011)**



**SREE NARAYANA COLLEGE, CHENGANNUR**

*Under the supervision*

*Of*

**Dr. N V Unnikrishnan**

**Visiting Professor**



**School of Pure and Applied Physics**

**Mahatma Gandhi University Kottayam-686560**

**April 2020**

*School of Pure & Applied Physics*

• *Mahatma Gandhi University*  
Kottayam-686560, Kerala,  
India

Email: [nvu100@yahoo.com](mailto:nvu100@yahoo.com) Phone: +91 9745047850

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## CERTIFICATE

This is to certify that the dissertation entitled "NOVEL POLYMER BASED  $\text{TiO}_2\text{-ZrO}_2$  THIN FILM COATINGS WITH MULTIFUNCTIONAL APPLICATIONS" submitted to the **University of Kerala** in partial fulfillment of the requirement for the award of the degree of **MASTER OF SCIENCE IN PHYSICS** is a record of original research work done by **KAVYA SASIDHARAN K K** during the period 2018-2020, under my guidance at Mahatma Gandhi University, Kottayam.

Dr. N.V. Unnikrishnan

Dr. N.V. UNNIKRIISHNAN  
Emeritus Scientist  
School of Pure & Applied Physics  
Mahatma Gandhi University  
Kottayam 686 560

## ABSTRACT

The blending of inorganic nanomaterials possessing high surface area with polymer systems to form hybrid materials is a promising category with abundant budding applications due to its exceptional mechanical, thermal and chemical stability. Herein, TiO<sub>2</sub>-Poly vinylpyrrolidone and TiO<sub>2</sub>-ZrO<sub>2</sub>-Poly vinylpyrrolidone composites synthesized using sol-gel method and are allowed for electro-spraying technique on aluminum foil and glass plates to get uniform film at optimum conditions (24 kV potential, 800 rpm and 1 ml /hr flow rate). Electrospinning, a technique that is mainly used for the fabrication of polymer nanofibers may sometimes produce peculiar structures such as spheres, ribbon-like and branched jet particles, etc. TiO<sub>2</sub> plays a major role in the photocatalytic oxidation of volatile organic compounds. Zirconia is considered as an appropriate counterpart to TiO<sub>2</sub> owing to its properties such as better chemical stability, higher melting point and good biocompatibility. Blending TiO<sub>2</sub> and ZrO<sub>2</sub> produces composite with high surface area possessing amorphous nature and enhances the quantum efficiency. The realization about the properties of TiO<sub>2</sub>-ZrO<sub>2</sub> microspheres is extremely significant as the peculiarity of this synthesis method.

The elemental composition and surface morphology of film is investigated by using elemental mapping assisted with energy dispersive spectroscopy which reveals the uniform distribution of C, O and Ti throughout both films whereas Zr distribution in TZP films. FESEM images clearly show smooth and compact nature for TP coatings inferring the homogeneous mixing of nanoparticles throughout the polymer matrix. The FTIR Spectroscopy image shows structure of composites. Contact angle measurements were carried out to assess self-cleaning nature of the film and also this measurement helps to calculate the surface and interfacial energy which describe the

RECORD OF PROJECT WORK ON

**STUDY OF OPTICAL PROPERTIES OF COPPER DOPED ZnS  
NANOPARTICLE**

*A dissertation submitted to University of Kerala on partial fulfillment of the requirements for  
the award of*

**MASTER OF SCIENCE IN PHYSICS**

By

**ATHIRA.P.NAIR**

UNDER THE GUIDANCE OF

**Dr. S. SARAVANA KUMAR**

ASSISTANT PROFESSOR

NSS COLLEGE,

PANDALAM



## **ABSTRACT**

ZnS nanoparticles have many applications in solar cells, gas sensor, anti-virus agent in coating and electroluminescent devices. The nonlinear properties of ZnS are very interesting for the production of optical devices. ZnS is chemically more stable and technologically better than other chalcogenides, so it is considered to be a promising host material. ZnS is an attractive candidate for applications in novel photonic devices operating from visible to near IR region. In the present work, nanoparticles of ZnS were prepared by arrested precipitation method using tri ethanol ammine (TEA) as capping agent. The effect of addition of copper in the photoluminescence (PL) spectra of nanoparticles of ZnS is analyzed. X-ray diffraction pattern of the ZnS nanoparticles was recorded and compared with the standard JCPDS values. From the JCPDS values, it was found that the ZnS nanoparticles of present study are in cubic phase. The grain size of ZnS nanoparticles was calculated from Debye-Scherrer equation and was found to be approximately 3 nm. UV-Visible absorption spectrum of nanoparticles of ZnS was recorded and an excitonic peak at 258 nm was observed in the absorption spectrum. The band gap of nanoparticles of ZnS was calculated to be 4.5 eV which was found to be higher than that of bulk ZnS. The grain size of nanoparticles of ZnS was calculated from the UV-Visible absorption spectra using Effective Mass Approximation and Hyperbolic Band Model and was found to be 2.5 and 3.4 nm respectively. The PL spectra of the samples were recorded at room temperature with an excitation wavelength of 330 nm. Nanoparticles of  $Zn_{1-x}Cu_xS$  were synthesized ( $x = 0.1, 0.2$  and  $0.3$ ) by co precipitation method. The effect of addition of copper in the band structure of ZnS was analyzed using photoluminescence technique.

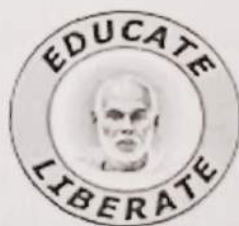
**A STUDY ON THE STRUCTURAL AND  
MAGNETIC PROPERTIES OF  
HYDROTHERMALLY PREPARED  
Cd<sub>95</sub>Fe<sub>5</sub>S NANOPARTICLES**

**A Dissertation submitted to the university of Kerala in  
partial fulfillment for the award of the degree of**

**MASTER OF SCIENCE IN PHYSICS**

**BY**

**DIVYA.R**



**Candidate code :63018128009**

**Subject code:PH201**

**Course code: 630**

**Exam code:63018401**

**Department Of Physics**

**SREE NARAYANA COLLEGECHENGANNUR**

**2020**

**ST. CYRIL'S COLLEGE**

**ADOOR**



**CERTIFICATE**

This is to certify the project report entitled "A STUDY ON THE STRUCTURAL AND MAGNETIC PROPERTIES OF HYDROTHERMALLY PREPARED  $Cd_{95}Fe_5S$  NANOPARTICLES " Submitted by Divya.R in partial fulfillment of the requirement for the award of the Msc degree in Physics is a record of bonafide work done by her and the work has not been published in my journal or magazine.

**PROF.REJEENA V RAJAN**

**HEAD OF THE DEPARTMENT OF PHYSICS**

**ST.CYRIL'S COLLEGE ADOOR  
ADOOR**

**DR.ANOOP CHANDRAN**

**ASSISTANT PROFESSOR**

**ST.CYRIL'S COLLEGE**

## ABSTRACT

Cadmium sulfide is a widely used material in the field of technology. Wurtzite cds nanoparticles with 5% of cd atoms are replaced by Fe atoms are prepared by hydrothermal method. The average crystalline size can be investigated using x-ray diffraction. Using Rietveld refinement to extract the structural details of the material from the x-ray diffraction pattern, and it gives the values of lattice parameter. HR-TEM studies shows the TEM image of the sample and average size of the particle. M-H curve shown the coercivity of the sample. The finding is of remarkable importance in the field of nanotechnology.



**Structural and optical studies of**  
**Copper doped Barium tartrate**  
**crystals**

*Project report submitted to the*

*University of Kerala*

*In partial fulfillment of the requirements for the award of the Degree of*

*MASTER OF SCIENCE*

*IN PHYSICS*

*By*

**SREYA P K**

Register No: 63018128017

**Department of physics**

Sree Narayana College

Chengannur

2018-2020



**DR. INDULAL C.R.**  
Assistant Professor,  
Dept. of Physics  
St. Gregorios College, Putanou  
D.O. Kottarakara - 691 331

**CERTIFICATE**

This is to certify that the dissertation entitled "**Ba-Cu Mixed Tartrate crystals: A Growth by Gel method and spectroscopic studies**" submitted to the University of Kerala in partial fulfillment of the requirement for the award of the degree of **MASTER OF SCIENCE IN PHYSICS** is a record of original research work done by **SREYA P K** during the period 2018-2020, under my guidance at St.Gregorios College, Kottarakara.

**DR. INDULAL C.R.**

## CHAPTER-1

### ABSTRACT

The regular surface geometry, the shiny and often colorful appearance have made crystals from the mineral kingdom fascinating objects for everybody. Natural crystals are grown by crystallization from solution relatively at low temperature.

Nowadays, crystals are artificially to satisfy the needs of science, technology and jewelry. The ability to produce high quality crystals has become an essential criterium for competitiveness of nations. Specializers in crystal growth, moved from periphery to the center of the material-based technology.

Growth of crystal demands the theoretical knowledge of thermodynamics, kinetics and transport processes. Also, the choice of raw materials, conditions, methods and characterization to be considered. Economical aspects dominate the developments in the future, that is growing large crystals at higher quality to raise yields and device performance.

*"New materials are the lifeblood of solid-state research and device technology. Contrary to what many believe, new materials are not usually discovered by device engineers, solid state theorists or research managers; they are mostly discovered by crystal growers. Some physical phenomena are only exhibited in single crystals and can only be studied and understood in single crystals. Thus, the crystal grower-especially if he develops a proficiency in relating structure, bonding and other chemo-physical*

*considerations to properties of interest-is a key position in determining the direction and success of solid-state research and-ultimately-technology”-Laudise.*

In this study, we investigated the structural and optical properties of Copper doped Barium tartrate crystals. We prepared the Copper tartrate, Barium tartrate and Copper doped Barium tartrate crystals by single diffusion reaction technique in silica gel medium. The XRD and UV spectroscopic analysis of Copper tartrate, Barium tartrate and Copper doped Barium tartrate crystals were examined in detail.



**RECORD OF PROJECT WORK ON  
STUDY OF EFFECT OF IRON DOPING ON THE  
PROPERTIES OF ZnS**

*A dissertation submitted to University of Kerala on partial fulfillment of  
the requirements for the award of*

**MASTER OF SCIENCE IN PHYSICS**

By

**LEKSHMI PRASAD**

UNDER THE GUIDANCE OF

**Dr. S. SARAVANA KUMAR**

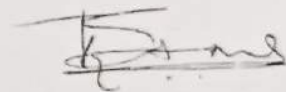
ASSISTANT PROFESSOR

NSS COLLEGE,

PANDALAM

## CERTIFICATE

This is to certify that the project report entitled “**STUDY OF EFFECT OF IRON DOPING ON THE PROPERTIES OF ZnS**” is a bonafide record of project presented by LEKSHMI PRASAD (Reg no:63018128012) during the academic year 2018-2020. This report is submitted to University of Kerala, Thiruvananthapuram in partial fulfillment of the requirements for the award of Master Degree in Physics.



Dr. S. Saravana Kumar

Assistant Professor

Department of Physics

NSS College, Pandalam

## ABSTRACT

Nanotechnology is defined as the design, development and application of materials and devices whose smallest functional make up is in nanometer and can be used across all the science fields such as physics, chemistry, biology and engineering. ZnS is an attractive candidate for applications in novel photonic devices operating from visible to near IR region. 3d transition-metal impurities in semiconductors can create deep levels within the band gap of the host materials and can act as luminescence centers, charge compensators and also as unwanted traps. In the present work, nanoparticles of ZnS were prepared by arrested precipitation method using tri ethanol ammine (TEA) as capping agent. The samples were characterized using X-ray diffraction method. The grain size of ZnS nanoparticles was calculated from Debye-Scherrer equation and was found to be approximately 3 nm. UV-Visible absorption spectrum of nanoparticles of ZnS was recorded and an excitonic peak at 258 nm was observed in the absorption spectrum. The band gap of nanoparticles of ZnS was calculated to be 4.5 eV which was found to be higher than that of bulk ZnS. The grain size of nanoparticles of ZnS was calculated from the UV-Visible absorption spectra using Effective Mass Approximation and Hyperbolic Band Model and was found to be 2.5 and 3.4 nm respectively. Nanoparticles of  $Zn_{1-x}Fe_xS$  were synthesized ( $x = 0.1, 0.2$  and  $0.3$ ) by co precipitation method. The effect of addition of iron in the band structure of ZnS was analyzed using photoluminescence technique. The PL spectra of the samples were recorded at room temperature with an excitation wavelength of 330 nm. The emission peak at 407 in the pristine ZnS samples was ascribed to the radiative transitions between acceptor level and conduction band and that at 434 between valance band and donor level. The peak at 462 nm was assigned as radiative transitions between the two trap levels. When compared to PL spectrum of pristine samples, the intensity ratio of the peak at 407 to 434 nm decreases with increase in the concentration of iron. The PL spectrum of the samples with highest concentration of iron ( $x=0.3$ ) shows two peaks at 495 and 520 nm. The peaks at 495 and 520 nm can be assigned as the radiative transitions from conduction band to the impurity level (created by the introduction of iron) and sulfur vacancy level to impurity level respectively.

RECORD OF PROJECT WORK ON  
SYNTHESIS AND CHARACTERIZATION OF  
Mn DOPED ZnS NANOPARTICLE

*A dissertation submitted to University of Kerala on partial fulfillment of the requirements for  
the award of*

**MASTER OF SCIENCE IN PHYSICS**

By

**RAKHI REGHU**

UNDER THE GUIDANCE OF

**Dr. S. SARAVANA KUMAR**

ASSISTANT PROFESSOR

NSS COLLEGE,

PANDALAM



## CERTIFICATE

This is to certify that the project report entitled “ **SYNTHESIS AND CHARACTERIZATION OF Mn DOPED ZnS NANOPARTICLE** ” is a bonafied record of project presented by RAKHI REGHU (Reg no:63018128015) during the academic year 2018-2020. This report is submitted to University of Kerala, Thiruvananthapuram in partial fulfillment of the requirements for the award of Master Degree in Physics.

External examiners

- 1.
- 2.

Dr. K. Sreelatha

Associate Professor

Department of Physics

Sree Narayana College, Chengannur

**SYNTHESIS AND CHARACTERIZATION OF CELLULOSE  
NANOFIBERS USING WASTE PAPER**

Project Report

Submitted to the University of Kerala

In partial fulfillment of the requirements for the award of the degree of

Master of Science in Physics

By

**ANAND MOHAN A**

(REG NO: 63018128003)



**SREE NARAYANA COLLEGE, CHENGANNUR**

*Under the supervision*

*Of*

**Dr. Vinoy Thomas**

Assistant Professor



Department of Physics

Christian college, Chengannur, University of Kerala

April 2020

## PREFACE

Cellulose is the main building material out of which plants are made. Cellulose has been using for multifunctional purposes such as papers, fuel, construction, building, food, and cosmetics, for many decades. Cellulose fibers can be extracted from different cellulose sources such as wood (hardwood and softwood) and non-wood sources (bamboo, rice straw, algae, and cattail) and waste paper as well. In recent years, cellulose nanofibers (CNFs) have been a trendy research subject, due to its lightweight and high mechanical properties. This work also demonstrated the preparation of highly porous and light weight CNF/PVA hydrogel. A hydrogel is a three-dimensional (3D) network of hydrophilic polymers that can swell in water and hold a large amount of water while maintaining the structure due to chemical or physical cross-linking of individual polymer chains.

The dissertation is divided into 3 chapters.

Chapter 1 of the dissertation includes an introduction about the project, characterization techniques and objectives.

Chapter 2 of the dissertation includes experimental setup.

Chapter 3 of the dissertation includes result and discussion.

AISWARYA. S



राष्ट्रीय पृथ्वी विज्ञान अध्ययन केन्द्र  
NATIONAL CENTRE FOR EARTH SCIENCE STUDIES

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PB No. 7250, Akkulam, Thiruvananthapuram-695011, India



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0471 2511620 (Off.) 9447552880 (Mob.)

23/07/2020

CERTIFICATE

This is to certify that the dissertation entitled "GEOCHEMISTRY AND POLLUTION ASSESSMENT OF CHALAKUDY RIVER BASIN" being submitted by Ms. Aiswarya. S, Postgraduate student, Department of Chemistry, S.N. College, Chengannur in partial fulfillment of the requirement for the award of Degree of Master of Science in Chemistry, is the record of the bonafide work carried out under my supervision and guidance in the Crustal Processes Group, National Centre for Earth Science Studies, Ministry of Earth Sciences, Govt. of India, Thiruvananthapuram and no part of the dissertation has been submitted in part or in full for any other diploma, degree of any university.

  
23.07.2020  
Dr. A. KRISHNAKUMAR

डॉ. ए. कृष्णकुमार / Dr. A. KRISHNAKUMAR  
वैज्ञानिक, क्रस्टल प्रोसेस ग्रुप / Scientist, Crustal Processes Group  
ई एस एस ओ राष्ट्रीय पृथ्वी विज्ञान अध्ययन केन्द्र  
ESSO-National Centre for Earth Science Studies  
पृथ्वी विज्ञान मंत्रालय, भारत सरकार  
Ministry of Earth Sciences, Govt. of India  
आक्कुलम, तिरुवनन्तपुरम-695 011, केरल  
Akkulam, Thiruvananthapuram-695 011, Kerala



## ABSTRACT

Rivers are the major geological agents in tropical and sub-tropical regions which transport tonnes of sediment from terrestrial environments to the ocean. It transports both anthropogenic and natural materials to the sea. And during the transportation the sediments undergo many physico-chemical changes depending on the term in characteristics and climatic conditions of the through which the river is flowing. The present study is done in the Chalakudy River basin. 20 samples from different locations of the riverine system are taken for detailed geochemical studies. The geochemical analysis shows the values of geoaccumulation index, contamination factor and pollution load index. From the detailed study of the sampling sites it is concluded that the area is prone to moderate pollution and as a need of an hour steps should be taken to control the pollution. Concentration of major and minor elements compared to that of world average shale value shows that Zr, Sr, Cr and Ba are slightly enriched in the area. Geo accumulation index based on the average value of each element was calculated and it was observed that V, Ni, Zn, Ga, Rb, Sr, Y, Ba, Nd, La, Ce are unpolluted to slightly polluted. From the study of degree of contamination parameter about 75% of the sample locations shows moderate degree of contamination and the remaining 25% shows considerable degree of contamination. And the PL1 study gives an idea that about 25% of the location doesn't show any contamination, 45% of the sample sites possess base line level pollution and the remaining 30% indicates progressive deterioration of the site. As per the whole study the river basin is moderately polluted but still the rate can be brought down by taking strict measures to maintain the quality of the river.

**SNEHA HARIDAS**

**SYNTHESIS OF PLANT MEDIATED GOLD NANOPARTICLES USING  
EMILIA SONCHIFOLIA AND BACOPA MONNIERI LEAVES EXTRACT  
AND EVALUATION OF THEIR ANTIMICROBIAL ACTIVITY**

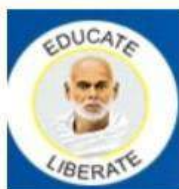
*A Project Report Submitted to the University of Kerala in Partial  
Fulfillment of requirements for the Degree of*

**MASTER OF SCIENCE IN  
CHEMISTRY**

*By*

**(SNEHA HARIDAS  
Reg No: 63518128014)**

**DEPARTMENT OF CHEMISTRY  
SREE NARAYANA COLLEGE  
CHENGANNUR**



**JULY 2020**

**SREE NARAYANA COLLEGE  
CHENGANNUR**

**GOPIKA G KRISHNAN**

**SREE NARAYANA COLLEGE**

**NEDUVARAMCODE P.O., CHENGANNUR, PIN: 689 508**

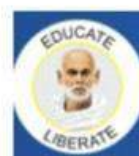
**Telephone: 0479-2136025, Fax: 0479-2360140**

**sncchengannur@gmail.com**

**Dr.Venu.S**

**Head of the Department**

**Post Graduate Department of Chemistry**



**Date: 20.07.2020**

### **CERTIFICATE**

This is to certify that the thesis entitled "**Green synthesis of silver nanoparticles and its application in photo catalytic dye degradation**" was carried by **Gopika G Krishnan, (Reg No: 23518128007)** student of M.Sc. VI<sup>th</sup> semester, Post Graduate Department of Chemistry, Sree Narayana College, Chengannur in partial fulfillment of the requirement for the award of Degree of Master of Science in Chemistry by the University of Kerala during the year, 2018-2020.

This work has been carried under the guidance of **Dr.Reshmi.R**, Assistant Professor, Post Graduate Department of Chemistry, Sree Narayana College, Chengannur.

Yours sincerely,

**Dr.Venu.S**

## ***ABSTRACT***

The scientific community is searching for new synthesis methods for the production of metallic nanoparticles. Green synthesis has now become a vast developing area of research. The green synthesis of metallic nanoparticles paved the way to improve and protect the environment by decreasing the use of toxic chemicals and eliminating biological risks in biomedical applications. Plant mediated synthesis of metal nanoparticles is gaining more importance owing to its simplicity, rapid rate of synthesis of nanoparticles and eco-friendliness. The present study reports an environmentally benign and unexploited method for the synthesis of silver nanocatalysts using Vitexuegudo(Karinochi), Psidiumguajava (Guava), Myristica Fragrance (Nutmeg) leaves extracts, which are a potential source of phylochemicals. The synthesized nano particles are characterized using UV—VIS spectroscopy, SEM, XRD and FTIR. The UV—visible absorption spectra of the silver samples exhibited distinct band centered around 500 nm. The major phylochemicals present in the plant extracts responsible for the formation of silver nanocatalysts are identified using FTIR spectroscopy. The report emphasizes the effect of the size of silver nanoparticles on the degradation rate of hazardous dye, methylene blue. The efficiency of silver nanoparticles as a promising candidate for the catalysis of organic dyes is established in the present study.



GOPIKA SATHYAN K S



DEPARTMENT OF APPLIED CHEMISTRY  
COCHIN UNIVERSITY OF SCIENCE AND TECHNOLOGY  
COCHIN-682022, KERALA, INDIA

Dr. N. Manoj  
Professor  
Email: manoj.n@cusat.ac.in  
Ph : 9447712268

### CERTIFICATE

This is to certify that the project work entitled: "D- $\pi$ -A fluoroionophores: synthesis and metal binding studies " is an authentic record of the project work carried out by Ms. Gopika Sathyan KS under my supervision in partial fulfillment of the requirements for the award of the degree of Master of Science in Chemistry, and is a record of bonafide work done by her.

Cochin-22,  
15-07-2020

Dr. N. Manoj  
(Supervising Guide)  
Professor  
Department of Applied Chemistry  
CUSAT

## ABSTRACT

Our work focuses on the synthesis and photophysical properties and metal binding studies of the D-z-A Fluoroionophores where barbituric acid act as acceptor group and carbazole as donor moiety. These D-z-A molecules have inherent Intramolecular charge transfer characters and thus the electron distribution favors metal binding. In this work we used carbazole- 1,3-dimethyl barbituric acid combination in order to confirm the binding activity of carbazole — barbituric acid which iaalready worked out, that is, we replaced the N-H bond with N — methyl groups.

We conducted the photophysical studies along with the metal binding studies of the D-z-A systems. The Absorption Spectra of carbazole dimethyl barbituric acid conjugate found to have broad absorption band at longer wavelength due to the influence of the heterocyclic receptor groups. A duplicated metal binding study is conducted for both carbazole — barbituric acid conjugate and carbazole-1,3 - dimethyl barbituric acid conjugate with a series of transition metal salts.

ARYA BABU



राष्ट्रीय पृथ्वी विज्ञान अध्ययन केन्द्र  
NATIONAL CENTRE FOR EARTH SCIENCE STUDIES  
पृथ्वी विज्ञान मंत्रालय, भारत सरकार  
Ministry of Earth Sciences, Government of India  
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PB No. 7250, Akkulam, Thiruvananthapuram-695011, India



21.07.2020

**Dr. K. Anoop Krishnan**  
Scientist & Supervising Guide  
Hydrological Processes Group

### CERTIFICATE

This is to certify that the dissertation entitled “An approach on the evaluation of hydrochemical parameters of Ashtamudi lake” submitted by Ms. Arya Babu, Department of Chemistry, Sree Narayana College, Chengannur in partial fulfillment of the requirement for the award of Master’s Degree in Chemistry of the University of Kerala is an authentic record of the original research work carried out by her under my supervision and guidance at National Centre for Earth Science Studies, Thiruvananthapuram and that no part thereof has been presented before for any degree.

**Dr. K. Anoop Krishnan**  
(Supervising Guide)

## ABSTRACT

The life in aquatic system is directly or indirectly depends on the water quality. The alteration of physicochemical parameters of water affects the abundance of biota and their diversity. Ashtamudi backwater has odd value for its hydrological functions and biodiversity. There are reports on the health of this estuary, which are dependent on the nature and quantity of various contaminants and toxic pollutants received by them. The main contaminants are sewage, synthetic organics, petroleum hydrocarbons, pesticides and toxic heavy metals. This is happening mainly due to rapid industrialization and modernization. The recreational role of the estuarine ecosystem is declining at a faster rate due to pollution. The Ashtamudi Lake shows differences in ecological conditions and hydrological factors. Hence an attempt was made to evaluate and confirm how far the hydrological parameters influence the different sites of the lake. physico chemical characteristics of the aquatic system indicate the extent of pollution existing there. Water quality is affected mainly by changes in various physico chemical factors. So it is inevitable to check regularly the quality of water, and thereby adopting necessary steps for the protection of the ecosystem by eliminating the factors responsible for pollution. A periodical survey and monitoring agenda must be a mandate concerned for the conservation of Ashtamudi lake and this study was believed to be a key indicator of pollution hazards on these non-renewable green boundaries. The study encompasses the fact for the need of conservation the lake by evaluating the hydro chemical parameters of water. Hence the present work has been taken up to study the water quality characteristics at selected sites of Ashtamudi Lake, which would help to evolve mitigation and control measures.



**MITHILA.P**

# QUALITY ANALYSIS OF DRUG: AMOXICILLIN CAPSULES

Project report submitted to:

KERALA UNIVERSITY, TRIVANDRUM

*In partial fulfillment of requirements for the degree of*

**MASTER OF SCIENCE IN CHEMISTRY**

By

**MIDHILA P**

Reg No: 63512818010

Year: 2018-2020



**Sree Narayana College Chengannur**

CHENGANNUR  
ASAPAZHA, KUTIAM



QUALITY ANALYSIS DEPARTMENT

KERALA STATE DRUGS AND PHARMACEUTICALS

Under the guidance of:

**SRI SPINWIN**

Under the Co-guidance of:

**Dr. Venu S**

DEPARTMENT OF CHEMISTRY

**SREE NARAYANA COLLEGE, CHENGANNUR**

## ABSTRACT

The quality analysis of drugs is of great importance for the efficient treatment and prevention of diseases with minimum side effect. For perfect curing, minimum side effects, better durability of the drugs, it has to satisfy certain requirements. That is the weight variation, dissolution, percentage of content of active ingredient etc. of the drugs

should be within a certain range as described in Indian Pharmacopoeia.

Challenging tasks like these require sophisticated techniques, dedicated equipment and methods

operated by highly skilled staff, often with a good academic background. The project work "Quality Analysis of Amoxicillin Capsules" was conducted in the quality control lab of Kerala State Drugs and Pharmaceuticals Ltd. Alappuzha. Bacterial infections are the second leading cause of global mortality. Considering this fact, it is extremely important

studying the antimicrobial agents. Amoxicillin is an antimicrobial agent that belongs to the class of penicillins. Amoxicillin is one of the most commonly used antibiotics in the primary care **setting**. It is an amino penicillin, created by adding an extra amino group to penicillin, to battle antibiotic resistance. Amoxicillin covers a wide variety of gram positive bacteria, with some added gram-negative coverage compared to penicillin. HPLC is the most widely used method for the amoxicillin determination due to its simplicity and low handling price. This involves comparative study of the percentage of

active ingredients present in Amoxicillin capsules. Study was carried out under different samples of 500 mg capsules of Amoxicillin.



**SYNTHESIS AND CHARACTERIZATION OF NOVEL COPPER  
AND ZINC COMPLEXES OF EDARAVONE AND ITS  
CARBOXYLIC ACID DERIVATIVE**

PROJECT REPORT

Submitted to the Department of Chemistry,

Sree Narayana College, Chengannur

for the partial fulfillment of the requirement for the degree of

MASTER OF SCIENCE

IN

CHEMISTRY

Submitted by

ATHULYA A

[ Reg. No: 63518128006 ]

Under the guidance of

DR. NAVEEN V. KULKARNI

Department of Chemistry

Amrita Vishwa Vidyapeetham, Amritapuri





**Dr. Naveen V. Kulkarni**

Amrita  
Amrita, India.

Email: [dr.naveenvk@gmail.com](mailto:dr.naveenvk@gmail.com);  
[naveenvkulkarni@am.amrita.edu](mailto:naveenvkulkarni@am.amrita.edu)

---

**CERTIFICATE**

This is to certify that the project entitled '**Synthesis and characterization of novel copper and zinc complexes of edaravone and its carboxylic acid derivative**' submitted in partial fulfillment of the requirement for the award of the degree of Master of Science in Chemistry to Department of Chemistry, Sree Narayana College, Chengannur done by Ms. Athulya A ( Reg. No: 63518128006 ), is an authentic work carried out by her under my guidance and supervision. The matter embodied in this dissertation has not formed the basis for the award of any Degree/Diploma/Associateship/ Fellowship to the best of my knowledge and belief.

Amritapuri

August 1, 2020. Naveen V. Kulkarni



This dissertation reports the purification and re-crystallization of edaravone (L1), synthesis of a carboxylic derivative of edaravone, viz, 5-oxo-1-phenyl-4,5-dihydro-1H-pyrazole-3-carboxylic acid (L2) and the corresponding copper and zinc complexes of both the molecules. Carboxylic derivative of the edaravone (L2) was synthesized by the  $\text{KMnO}_4$  mediated oxidation of edaravone and characterized by CHN analysis and IR spectroscopy. Copper and zinc complexes of both the ligands L1 & L2 were synthesized by reacting the ligands with the appropriate metal precursors in 2:1 stoichiometric ratio, under suitable reaction conditions. Complexes of L1 were characterized by C, H, N, Metal and chloride analysis and IR spectroscopy, while for the complexes of L2 we could perform only metal and chloride estimations. Based on the available spectro-analytical data an octahedral coordination geometry was assigned for all the four complexes. Complexes C1 & C2 are envisaged to be isostructural, with the two molecules of the mono dentate neutral ligand (L1) bound to the metal center via pyrazole ring nitrogen and the other four sites are occupied by two hydroxy and two aqua ligands. In the case of complexes C3 & C4, two molecules of the bidentate, monoanionic ligand L2 are predicted to bind the metal center through pyrazole ring nitrogen and carboxylic hydroxy group, forming an approximate

awaiting on the other spectral data to confirm the molecular structures of the compounds. After the thorough structural elucidation, potential antioxidant property of all the synthesized compounds will be evaluated. Emphasis will be given to establish the structure activity relationships.



AJIL S T

**BIOSYNTHESIS OF PLANT SUPPORTED**  
**SILVER NANOPARTICLES FOR**  
**PHOTOCATALYTIC DYE DEGRADATION**  
**UNDER SUNLIGHT**

*A Project Report Submitted to the University of Kerala in Partial Fulfillment of  
requirements for the Degree of*

**MASTER OF SCIENCE IN CHEMISTRY**

**By**

**Reg No: 63518128002**

**Course code: 635**

**Exam code: 63516403**

**Dissertation code:**



July 2020

## **ABSTRACT**

The quality analysis of drug has the great importance for the efficient treatment and prevention of bacterial infections.

"ANALYSIS AND QUALITY CONTROL OF CLOXACILLIN" is the quality analysis of two different samples of cloxacillin. Cloxacillin is an antibiotic useful for the treatment of a number of bacterial infections. This includes impetigo, cellulitis, pneumonia, septic arthritis, and otitis externa. Hence the quality analysis of cloxacillin is very important. For perfect curing, minimum side effects, better durability of the drugs, it have to satisfy certain requirement. That is the weight variation, dissolution, percentage of content of active ingredients etc of the drug should be within a certain range as described in Indian pharmacopeia. Instrumental methods are widely used for the analysis and stability of compound in bulk and pharmaceutical form. The dissolution of drug is important for its bioavailability and therapeutic effectiveness. Dissolution of cloxacillin capsule is carried out by quick and easy UV-Visible spectrophotometer method. It is based on absorbance of the sample solutions of cloxacillin maximum at 271 nm. The assay of drug is carried out by simple, specific, and rapid HPLC method. The objectives of this study include the comparative study of weight variation, dissolution and percentage content of the

**ANJANA RAJ T**



**Dr. BEENA S.**  
**Assistant Professor**  
**Department of Chemistry**

**05.08.2020**

**CERTIFICATE**

This is to certify that the thesis report entitled “**Poly (Riboflavin) Modified Pencil Graphite for the Simultaneous Electrochemical Determination of Serotonin and Dopamine**” has been carried out by **Anjana Raj T (63518128003)**, under my guidance and supervision at the **Department of Chemistry, Amrita School of Arts & Sciences, Amrita Vishwa Vidyapeetham, Amritapuri, Kollam – 690 525**, as part of the final project work for her master Degree in Chemistry, is an authentic record of the work carried out by her under my supervision and no part of this report has formed the basis for the award of any degree, diploma or other similar titles of any University.

Amritapuri

05.08.2020

**Dr. Beena S.**



**“Poly (Riboflavin) modified Pencil Graphite for  
the Simultaneous Electrochemical Detection of Serotonin  
and Dopamine”**

*University of Kerala, Thiruvananthapuram*

*Master of Science in Chemistry*

Registration Code: 63511/BOU3

Year: 2018 - 2019



**Sree Narayana college, Chengannur**

KARISHMA. H



Department of Applied Chemistry  
Cochin University of Science and Technology  
Kochi 682 022, India

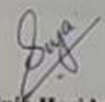
**Dr. Suja Haridas**  
Assistant Professor  
Email: sujaharidas123@gmail.com

### Certificate

This is to certify that the thesis entitled "**Perovskite Nanocrystals For Electrocatlytic Applications**" submitted by **Ms. Karishma. H** in partial fulfilment of the requirements for the degree of Master of Science in Chemistry, to the Cochin University of Science and Technology, Kochi-22, is an authentic record of the original work carried out by him under my guidance and supervision. The results embodied in this thesis, in full or in part, have not been submitted for the award of any other degree.

Kochi-22

13/07/2020

  
**Dr. Suja Haridas**

(Supervising Guide)  
**DR. SUJA HARIDAS**  
ASSISTANT PROFESSOR  
Dept. of Applied Chemistry  
Cochin University of Science & Technology  
Kochi, Kerala

RESHMA PUSHKARAN

**PHARMACOLOGY AND ASSAY OF AMLODIPINE TABLETS**

*A Project Report Submitted to the University of Kerala in Partial  
Fulfillment of requirements for the Degree of  
Master of Science in Chemistry*



**August 2020**

## **ABSTRACT**

Aim of the project is to evaluate the pharmacology and assay of amlodipine tablet of two different sample. Pharmacology and assay are of great importance for the efficient treatment and prevention of disease with minimum side effects. Amlodipine besilate is a potent long-acting calcium channel blocking agent used for the treatment of hypertension, congestive heart failure and angina pectoris. For perfect curing, minimum side effects, better durability of the drug, it has to satisfy certain requirements. That is the weight variation, dissolution, percentage of content of active ingredients etc., of the drug should be within a certain range as described in Indian pharmacopeia. An efficient least time consuming and simple spectrophotometric method for the dissolution of Amlodipine has been used. Dissolution is an important step during preformulation studies because the rate of drug dissolution of a drug will exert a direct impact on bioavailability and drug delivery aspects. The dissolution is based on the ultraviolet UV absorbance maxima at about 239nm wavelength of Amlodipine. In this study a simple and quick assay method using HPLC analysis is used. This involves comparative study of percentage of active ingredient present in amlodipine tablets. Study was carried out in two different samples of 5 mg tablet of amlodipine.



**SREE NARAYANA COLLEGE**

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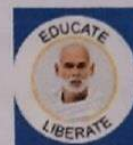
**Telephone: 0479-2136025, Fax: 0479-2360140**

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**Dr.Venu.S**

**Head of the Department**

**Post Graduate Department of Chemistry**



**Date: 26.07.2020**

### **CERTIFICATE**

This is to certify that the thesis entitled "Synthesis And Characterization of Palladium Nanoparticles Using Leaf Extract of Justicia gendarussa and Emilia sonchifolia: Evaluation of Antimicrobial activities" was carried by Revathy Krishnan, Reg No: (63518128012) student of MSc. IV<sup>th</sup> semester, Post Graduate Department of Chemistry, Sree Narayana College, Chengannur in partial fulfillment of the requirement for the award of Degree of Master of Science in Chemistry by the University of Kerala during the year, 2019-2020.

This work has been carried under the guidance of Dr. Reshmi. R, Assistant Professor, Post Graduate Department of Chemistry, Sree Narayana College, Chengannur.

Yours sincerely,

## ABSTRACT

The synthesis of nanoparticles using plant extracts is the most adopted method as green ecofriendly production of nanoparticles and also has a special advantage in such a way that the plants are widely distributed easily available much safer to handle and act as a source of several metabolites rich in pharmacological constituents. Plant mediated synthesis of metallic nanoparticles is an increasing commercial demand due to the wide applicability in various areas such as electronics, catalysis, chemistry, energy, cosmetics and medicine. This study presents the biological synthesis of palladium nanoparticles using plant leaf extracts of *Justicia gendarussa* (Vathamkolli) and *Emilia Sonchifolia* (Oricheviyan) as reducing and stabilizing agents. UV-Visible spectroscopy was used to monitor the quantitative formation of palladium nanoparticles. The as-synthesized nanoparticles were characterized by XRD and SEM. The XRD analysis of palladium nanoparticles indicated the formation of crystalline nanoparticles. X-ray diffraction (XRD) spectral results confirmed the face centered cubic (FCC) structure of nanoparticles with high stability and without any impurity. Investigations on the antibacterial effect of the as-synthesized palladium nanoparticles that were performed against pathogenic bacteria, *Escherichia coli* and *Staphylococcus aureus*, reveal that due to the difference in particle size the samples were not active against the bacteria tested. In conclusion, this greener approach toward the synthesis of palladium nanoparticles, using plant leaf material as reducing and capping agent, has many advantages such as ease with which the process can be scaled up, economic viability, environmentally benign and renewable, there is no need to use high pressure, energy, temperature and toxic chemicals.

Keywords: Antibacterial Activity, Biosynthesis, Characterization, Copper Nanoparticles, Surface Plasmon Resonance.

VISHNUPRIYA M B

**PHARMACEUTICAL ANALYSIS AND QUALITY CONTROL OF  
CLOXACILLIN**

*A Project Report Submitted to the University of Kerala in Partial  
Fulfillment of requirements for the Degree of*

**MASTER OF SCIENCE IN  
CHEMISTRY**

By

**Reg No: 63518128015**

**Exam code: 63516403**

**Course Code:635**

**Dissertation code: CH243(a)**



**August 2020**

REVATHY VENUGOPAL

GREEN SYNTHESIS OF SILVER NANOPARTICLES AND ITS APPLICATION IN  
PHOTOCATALYTIC DYE DEGRADATION USING CHROMOLAENA ODORATA  
AND JUSTICIA ADHATODA

*A Project Report Submitted to the University of Kerala in Partial Fulfillment of  
requirements for the Degree of*

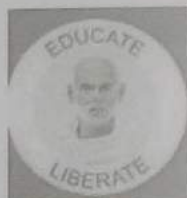
MASTER OF SCIENCE IN CHEMISTRY

*By*

(Revathy Venugopal (Reg No: 63518128013,))

DEPARTMENT OF CHEMISTRY SREE NARAYANA COLLEGE

CHENGANNUR



JULY 2020

SREE NARAYANA COLLEGE

CHENGANNUR

**2017-2019**

**THE SYNTHESIS AND CHARACTERIZATION OF  
NANOPARTICLES OF IRON OXIDE**

Project Report

Submitted to the University of Kerala  
in partial fulfillment of the requirements

for the Degree of  
Master of science in Physics

By

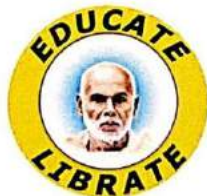
**HIMA.P.S.**

**Reg. No: 63017128003**

*Under the supervision of*

**Dr. S. SARAVANA KUMAR**

Assistant Professor  
Department of Physics,  
NSS College Pandalam



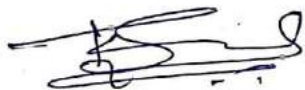
Department of Physics,  
Sree Narayana College,  
Chengannur

**2019**



## CERTIFICATE

This is to certify that the project report, entitled "SYNTHESIS AND CHARACTERIZATION OF NANOPARTICLES OF IRON OXIDE", submitted to the University of Kerala, in partial fulfillment of the requirement for the award of the degree of **Master of science in physics** is a record of work done by **HIMA P. S.**, Reg .No .63017128003 during the period 2017-2019 of her study in the Department of Physics, SREENARAYANA COLLEGE Chengannur under my supervision and guidance and the project has not formed the basis for the award of any Degree/ Diploma/ Associateship/ Fellowship or other similar title to any candidate of any university.



**Dr. S. Saravana Kumar**


Assistant professor

Department of Physics

NSS College Pandalam

(Project guide)

**Dr. S. SARAVANA KUMAR**  
Assistant Professor  
Department of Physics  
NSS College, Pandalam



**K. Sreeletha**

HOD

**Dr. K. SREELATHA**  
Assistant Professor & Head  
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Chengannur - 689508

Submitted for the viva voice held on.....at.....

**Examiner**

## Abstract

Nanocrystalline materials have been the subject of widespread research over the past couple of decades with significant advancement in their understanding especially in the last few decades. In the present work, nanoparticles of iron oxide were synthesized using chemical precipitation method. The structural properties of the samples were analysed using X-ray diffraction and Raman techniques. Both the studies revealed that the iron oxide nanoparticles of present study are in magnetite phase. The dislocation density and micro strain were calculated from the XRD pattern. The size of the nanoparticles was calculated using Debye-Scherrer equation and is approximately 16 nm. The band gap of iron oxide nanoparticles was calculated from UV-Visible absorption spectrum and was found to be blue shifted due to quantum confinement effect. Photoluminescence emission spectrum of the samples showed emission peaks corresponding to defect levels.

**Study of Black Carbon Mass Concentration  
And Angstrom Absorption Exponent  
During Winter and Post Monsoon Seasons  
over Thiruvananthapuram.**

*Project report submitted to the University of Kerala for partial fulfillment of the  
award of the degree of*

**Master of Science**

**In**

**Physics**

**By**

**KEERTHY V.R.**

Under the supervision of

**Mr. ARUN KUMAR V.H.**

Scientist-B,

Indian meteorological Department,

Thiruvananthapuram.



2019

भारतसरकार  
भारतमौसमविज्ञानविभाग  
(पृथ्वीविज्ञानमंत्रालय)  
मौसमकेन्द्र  
विकासभवनपीओ  
तिरुवनंतपुरम - 695 033



GOVERNMENT OF INDIA  
INDIA METEOROLOGICAL  
DEPARTMENT  
(Ministry of Earth Sciences)  
METEOROLOGICAL CENTRE  
VikasBhavan P.O  
Thiruvananthapuram - 695033

Date:16/09/2019

## CERTIFICATE

This is to certify that the project report entitled "Study of Black carbon Mass Concentration and Angstrom Absorption Exponent during Winter and Post-Monsoon Season over Thiruvananthapuram" being submitted to University of Kerala, Thiruvananthapuram in partial fulfillment of the requirement for the award of the M.Sc. Degree in Physics represents a work carried at the Meteorological Centre, Thiruvananthapuram by KEERTHY V. R., Department of Physics, Sree Narayana College Chengannur, under my supervision and guidance.



ARUN KUMAR V H  
Scientist-B

अरुण कुमार. वी. एच./ARUN KUMAR. V. H  
वैज्ञानिक वी / Scientist B  
मौसम विज्ञान केंद्र, तिरुवनंतपुरम / Met. Centre, Thiruvananthapuram  
भारत मौसम विज्ञान विभाग / India Meteorological Department  
पृथ्वी विज्ञान मंत्रालय / Ministry of Earth Sciences  
भारत सरकार / Govt. of India

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## ABSTRACT

Aerosols are minute particles suspended in the atmosphere. When these particles are sufficiently large, we notice their presence as they scatter and absorb sunlight. The additional reflection caused by pollution aerosols is expected to have an effect on the climate. The effect of the aerosols, however, will be opposite to the effect of the increasing atmospheric trace gases - cooling instead of warming the atmosphere.

**Black carbon (BC)** aerosol, often called soot, is the dominant form of light absorbing particulate matter in the atmosphere. BC is emitted by incomplete combustion processes, both human and natural. Its ability to absorb visible and infrared radiation means BC can heat the atmosphere and darken surfaces, specifically snow and ice. These effects have important consequences on earth's climate and climate change. BC may also have adverse impacts on human health.

In this project, the black carbon mass concentration for winter and post monsoon seasons is studied. The data is collected for the year 2018 from the experimental site, Indian Meteorological Department Thiruvananthapuram using Aethalometer. In addition to the analysis of mass concentration of black carbon, Angstrom Absorption Exponent (AAE) is also estimated.

The chapter 1, "Introduction" gives an overall concept about aerosols and atmosphere. The next chapter includes "Review of Literature" which explains the thesis done by other research faculties. Chapter 3 "Instrumentation" includes details about the instrument used and the experimental method. Chapter 4 contains the "Result and Discussion", conclusions and reference of the study.



**STUDY OF OPTICAL AND VIBRATIONAL PROPERTIES OF CdS  
NANOPARTICLES**

Project Report

Submitted to the University of Kerala  
in partial fulfillment of the requirements  
for the Degree of  
Master of science in Physics

By

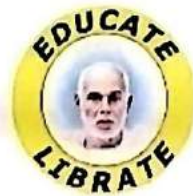
**KAVYA SURENDRAN**

**Reg. No: 63017128004**

*Under the supervision of*

**Dr. S. SARAVANA KUMAR**

Assistant Professor  
Departement of Physis,  
NSS College Pandalam

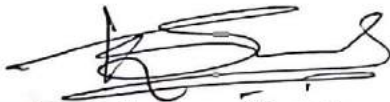


Departement of Physics,  
Sree Narayana College,  
Chengannur

**2019**

# CERTIFICATE

This is to certify that the project report entitled “**STUDY OF OPTICAL AND VIBRATIONAL PROPERTIES OF CdS NANOPARTICLES**” submitted to the University of Kerala, in partial fulfillment of the requirement for the award of the degree of **Master of Science in Physics** is a record of work done by **Kavya Surendran** , Reg.No.63017128004 during the period 2017-2019 of her study in the Department of Physics, SREENARAYANA COLLEGE Chengannur under my supervision and guidance and the project has not formed the basis for the award of any Degree/ Diploma/ Associateship/ Fellowship or other similar title to any candidate of any university.



**Dr. S. Saravana Kumar**

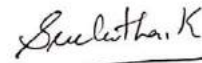
Assistant professor

Department of Physics

NSS College Pandalam

(Project guide)

**Dr. S. SARAVANA KUMAR**  
Assistant Professor  
Department of Physics  
NSS College, Pandalam



**K. Sreeletha**

HOD

**Dr. K. SREELATHA**  
Assistant Professor & Head  
Department of Physics  
Sree Narayana College  
Chengannur - 689508

Submitted for the viva voice held on.....at.....

**Examiner**

**STUDY ON THE INFLUENCE OF TROPICAL CYCLONE-  
PHAILIN ON THE RELATIVE HUMIDITY DISTRIBUTION OVER  
THE INDIAN REGION**

*Dissertation submitted to*

*University of Kerala*

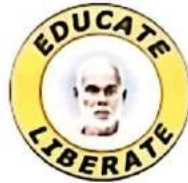
*In partial fulfillment of the requirements for the award of the degree of*

*Master of Science in Physics*

By

**SHILPA K**

*Reg. No. 63017128010*



**Department of Physics  
Sree Narayana College  
Chengannur**

*Under the Guidance*

*Of*

**Dr. Siddarth Shankar Das**



**Space Physics Laboratory  
Vikram Sarabhai Space Centre  
Indian Space Research Organisation  
Thiruvananthapuram-695022, India**

**May 2019**

भारत सरकार  
अंतरिक्ष विभाग  
विक्रम साराभाई अंतरिक्ष केन्द्र  
तिरुवनन्तपुरम-695 022  
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तार/Gram: SPACE  
Website : www.vssc.gov.in & www.spl.gov.in



Government of India  
Department of Space  
**Vikram Sarabhai Space Centre**  
Thiruvananthapuram-695 022  
Kerala, INDIA  
Telephone : (0471) 2562159  
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ई-मेल/e-mail: siddarth\_das@vssc.gov.in  
dassiddhu@yahoo.com

डॉ. सिद्धार्थ शंकर दास /Dr. SIDDARTH SHANKAR DAS  
वैज्ञानिक-एसएफ /Scientist-SF  
अंतरिक्ष भौतिकी प्रयोगशाला / SPACE PHYSICS LABORATORY

मई/May 31, 2019

## Certificate

*This is to certify that the Project report entitled, "Study on the Influence of Tropical cyclone-Phailin on the Humidity Distribution over the Indian Region" is a bonafide record of research work done by Ms.Shilpa.K, Department of Physics, Sree Narayana College, Chengannur, Kerala during the period of March-May 2019. She has carried out the study under my supervision and guidance for the award of the degree of Master of Science in Physics of University of Kerala. This is her original contribution and has not been submitted for award of any Degree or Diploma to any University or Institution.*

सिद्धार्थ शंकर दास /Siddarth ShankarDas



डॉ. सिद्धार्थ शंकर दास / Dr.Siddarth Shankar Das  
वैज्ञानिक - एसएफ / Scientist - SF  
अंतरिक्ष भौतिकी प्रयोगशाला / Space Physics Laboratory  
विक्रम साराभाई अंतरिक्ष केन्द्र / Vikram Sarabhai Space Centre  
इसरो - अंतरिक्ष विभाग / ISRO - Dept. of Space  
भारत सरकार / Government of India  
तिरुवनन्तपुरम / Thiruvananthapuram-695 022

भारतीय अंतरिक्ष अनुसंधान संगठन



Indian Space Research Organisation

**“SYNTHESIS AND CHARACTERIZATION OF  
THINFILM IN EFFECT OF ANNEALING BY SILAR  
METHOD”**

**Dissertation**

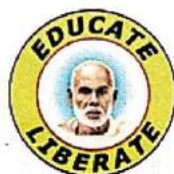
**Submitted to University of Kerala, Trivandrum**

*In partial fulfillment of the requirements for the award of the degree of  
Masters of Science in Physics*

**By**

**NAVITHAKRISHNA K**

**(REG NO: 63017128006)**



**SREE NARAYANA COLLEGE**

**Under the supervision**

**Of**

**Dr. K C Preetha**

**Head of Department**



**Sree Narayana College, Kannur**

***August 2019***





**Post Graduate Department of Physics**

**Sree Narayana College**

**Kannur-670007, Kerala, India**


**(Affiliated to Kannur University)**

**Dr. K. C Preetha, M.Sc, B.Ed, M.Phil, Ph.D, PGDCP**  
Associate Professor & Head of the Department  
Research Guide, Kannur University

Symphony  
Near Puzhathi Temple, Chirakkal.P.O  
PIN 670011  
Kannur, Ph: 9895262736

**CERTIFICATE**

This is to certify that Ms. NAVITHAKRISHNA K, M. Sc. student from Sree Narayana College, Chengannur, Kerala University carried out her M. Sc. project work on the topic **“Synthesis And Characterization Of Thin film In Effect Of Annealing By SILAR Method”** under my guidance at Dept. Of Physics, Sree Narayana College, Kannur.

  
Dr. K.C. PREEATHA  
Associate Professor  
Department of Physics  
Sree Narayana College  
Kannur - 670 007

## ABSTRACT

Thin film solar cells put forward the most promising option for reducing the cost of photovoltaic system which is now commercialized based on amorphous and polycrystalline silicon. The advancement in the thin film technology had resulted in the rapid development of miniature and highly integrated electronic circuits, which contain the materials of exceptionally high quality, reproducible characteristics and reliability.

The preparation of group, and polycrystalline chalcogenide semiconductor through the chemical route is significant view of its wide applications especially in the field of photovoltaic. Also due to suitable band gaps PbS thin film is extensively used in IR detectors and solar cell. Since it possesses third order non-linear optical behaviour makes potentially useful in electroluminescent device.

The project aims the synthesis and characterization of chemically doped PbS thin film by SILAR method and study the effect of annealing on this thin film.

**Comparison of Black Carbon Mass Concentration  
and Angstrom Absorption Exponent during  
Winter Season of 2016, 2017 and 2018  
over Thiruvananthapuram**

*Project Report submitted to the University of Kerala  
in partial fulfillment for the award of the Degree of*

**Master of Science in Physics**

by

**ADITHYA S R**

*Under the supervision of*

**ARUN KUMAR V H**

Scientist B

Indian Meteorological Department

Thiruvananthapuram

Kerala



2019

भारतसरकार  
भारतमौसमविज्ञानविभाग  
(पृथ्वीविज्ञानमंत्रालय)  
मौसमकेन्द्र  
विकासभवनपीओ  
तिरुवनंतपुरम - 695 033



GOVERNMENT OF INDIA  
INDIA METEOROLOGICAL  
DEPARTMENT  
(Ministry of Earth Sciences)  
METEOROLOGICAL CENTRE  
VikasBhavan P.O  
Thiruvananthapuram - 695033

## CERTIFICATE

This is to certify that the project report entitled "Comparison of Black Carbon Mass Concentration and Angstrom Absorption Exponent during Winter season of 2016, 2017 and 2018 over Thiruvananthapuram" being submitted to University of Kerala, Thiruvananthapuram in partial fulfilment of the requirement for the award of the MSc Degree in Physics represents a work carried at the Meteorological Centre, Thiruvananthapuram by ADITHYA S R, Department of Physics, SreeNarayana College, Chengannur under my supervision and guidance.



A handwritten signature in black ink, appearing to read 'Arun Kumar V H'.

ARUN KUMAR V H  
Scientist-B

अरुण कुमार. वी. एच./ARUN KUMAR. V. H  
वैज्ञानिक बी / Scientist B  
मौसम विज्ञान केंद्र, तिरुवनंतपुरम / Met. Centre, Thiruvananthapuram  
भारत मौसम विज्ञान विभाग / India Meteorological Department  
भारतीय विज्ञान मंत्रालय / Ministry of Earth Sciences  
भारत सरकार / Govt. of India

## ABSTRACT

Atmospheric physics is the branch of meteorology that apply physics to study of the atmosphere. For example, atmospheric physics deals with the properties of the gases that constitute the atmosphere, the absorption and emission of radiation by the gases, the distribution of temperature and pressure, the evaporation and condensation of water vapor, the formation of clouds and precipitation, and the various forms of motion in the atmosphere.

Atmospheric physicists attempt to model atmosphere using fluid flow equations, radiation balancing, and energy transfer processes in the atmosphere and underlying oceans. In order to model weather systems, they employ elements of scattering theory, wave propagation models, cloud physics, statistical mechanics and spatial statistics. It also covers the design and construction of instruments for studying the atmosphere and the interpretation of the data they provide, including remote sensing instruments.

Aerosols are suspensions of solid or liquid particles in a gas. Aerosols particles play an important role in the overall energy balance of the atmosphere by scattering and absorbing incoming and outgoing radiation. The determination of the direct effects of aerosols on the earth radiation balance requires quantitative information on the optical properties of atmospheric aerosols. This project is a record of my dedicated work based on diurnal variation of black carbon mass concentration in tropical coastal station of Thiruvananthapuram in the year 2016, 2017 and 2018 and its analysis. The period of study is selected such a way to see how diurnal variation and angstrom absorption varies over winter season. It also acquaints about meteorological instrument, theory and methods used for measuring diurnal variation and angstrom absorption coefficient.



**“FORMATION OF H II REGIONS AROUND  
MASSIVE STARS”**

**Dissertation**

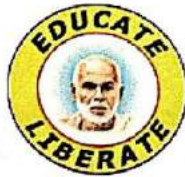
**Submitted to University of Kerala, Trivandrum**

*In partial fulfillment of the requirements for the award of the degree of  
Masters of science in Physics*

**By**

**VINAYA M. K**

**(REG NO: 63017128011)**



**SREE NARAYANA COLLEGE**

*Under the supervision*

*Of*

**Dr. Anand Narayanan**

**Associate Professor**



**Department of Earth &Space Sciences**

**Indian Institute of Space Science and Technology**

*August 2019*



**INDIAN INSTITUTE OF SPACE SCIENCE & TECHNOLOGY**  
(An autonomous Institution under Department of Space, Govt. of India)  
Valiamala P O, Thiruvananthapuram - 695547, Kerala, INDIA

---

August 18, 2019

Dr. Anand Narayanan  
Associate Professor  
Department of Earth & Space Sciences

Phone: (91-471) 256-8518  
+91-9495960960  
Email: anand@iist.ac.in

### CERTIFICATE

This is to certify that Vinaya M. K., MSc Physics student of Sree Narayana College, Chennamangalam, did her final semester research project on the "**Formation of H II Regions Around Massive Stars**" under my supervision at the Indian Institute of Space Science & Technology. She has fulfilled the goals and objectives set initially for this project.

Anand Narayanan



## ABSTRACT

The ionizing stars have a blackbody curve and most of their ionizing photons are in the high frequency tail of blackbody spectrum and possess energies greater than 13.6 eV needed to ionize the hydrogen. Here, first of all drawing the Blackbody spectrum of main sequence stars using python coding. Labeling the curve at 13.6 eV vertically and it shows that O and B stars possess the energy at 13.6 eV and above. From the Planck function, equation for rate of Lyman continuum photons is found out. Python code for rate of Lyman continuum photons and Strömgren radius is computed. Using this data a bar diagram is drawn, which can explain the relation of stars with the Strömgren radius very easily. And the diagram finally explains that massive stars, that is O -B stars are primarily responsible for the production of H II regions, and the Strömgren sphere which gives an evolutionary feedback of interstellar medium.

**CASE STUDY ON INDUSTRIAL FIRE  
BREAKOUT USING BLACK CARBON DATA  
FROM AETHALOMETER**

*Dissertation submitted to the University of Kerala for partial fulfillment for the  
award of the Degree of*

**MASTER OF SCIENCE**

**IN**

**PHYSICS**

By

**RENJU R NAIR**

*Under the supervision of*

**ARUN KUMAR V H**

Scientist B

India Meteorological Department  
(Ministry of Earth Sciences (MoES))  
Meteorological centre  
Thiruvananthapuram



2019

भारत सरकार  
भारत मौसम विज्ञान विभाग  
(पृथ्वी विज्ञान मंत्रालय)  
मौसम केन्द्र  
विकास भवन पी ओ  
तिरुवनंतपुरम - 695 033



GOVERNMENT OF INDIA  
INDIA METEOROLOGICAL  
DEPARTMENT  
(Ministry of Earth Sciences)  
METEOROLOGICAL CENTRE  
Vikas Bhavan P.O  
Thiruvananthapuram - 695033

Date: 15.09.2019

## CERTIFICATE

This is to certify that the project report entitled “CASE STUDY ON INDUSTRIAL FIRE BREAKOUT USING BLACK CARBON DATA FROM AETHALOMETER” being submitted to University of Kerala, Thiruvananthapuram in partial fulfilment of the requirement for the award of the MSc Degree in Physics represents a work carried at the Meteorological Centre, Thiruvananthapuram by RENJU R NAIR, Department of Physics, Sree Narayana College, Chengannur under my supervision and guidance.



ARUN KUMAR V H  
Scientist-B

अरुण कुमार. वी. एच./ARUN KUMAR. V. H  
वैज्ञानिक बी / Scientist B  
मौसम विज्ञान केन्द्र, तिरुवनंतपुरम / Met. Centre, Thiruvananthapuram  
भारत मौसम विज्ञान विभाग / India Meteorological Department  
पृथ्वी विज्ञान मंत्रालय / Ministry of Earth Sciences  
भारत सरकार / Govt. of India



## ABSTRACT

Atmospheric physics is the branch of meteorology that applies physics to study of the atmosphere. For example, atmospheric physics deals with the properties of the gases that constitute the atmosphere, the absorption and emission of radiation by the gases, the distribution of temperature and pressure, the evaporation and condensation of water vapour, the formation of clouds and precipitation, and the various forms of motion in the atmosphere.

Atmospheric physicists attempt to model atmosphere using fluid flow equations, radiation balancing, and energy transfer processes in the atmosphere and underlying oceans. In order to model weather systems, they employ elements of scattering theory, wave propagation models, cloud physics, statistical mechanics and spatial statistics. It also covers the design and construction of instruments for studying the atmosphere and the interpretation of the data they provide, including remote sensing instruments.

Aerosols are suspensions of solid or liquid particles in a gas. Aerosols particles play an important role in the overall energy balance of the atmosphere by scattering and absorbing incoming and outgoing radiation. The determination of the direct effects of aerosols on the earth radiation balance requires quantitative information on the optical properties of atmospheric aerosols. This project is a record of my dedicated work based on diurnal variation of black carbon mass concentration in tropical coastal station of Thiruvananthapuram during October and November of 2018 and its analysis. The period of study is selected such a way to see how diurnal variation and angstrom absorption varies according to an event. It also acquaints about meteorological instrument, theory and methods used for measuring diurnal variation and angstrom absorption coefficient.

**“SYNTHESIS AND CHARACTERIZATION OF  
THINFILM IN EFFECT OF COOLING BY SILAR  
METHOD”**

**Dissertation**

**Submitted to University of Kerala, Trivandrum**

*In partial fulfillment of the requirements for the award of the degree of  
Masters of science in Physics*

**By**

**NEESHMA P.P**

**(REG NO: 63017128007)**



**SREE NARAYANA COLLEGE**

**Under the supervision**

**Of**

**Dr. K C Preetha**

**Head of Department**



**Sree Narayana College, Kannur**

**August 2019**



**Post Graduate Department of Physics**

**Sree Narayana College**

Kannur-670007, Kerala, India


(Affiliated to Kannur University)

Dr. K. C Preetha, M.Sc, B.Ed, M.Phil, Ph.D, PGDCP  
Associate Professor & Head of the Department  
Research Guide, Kannur University

Symphony  
Near Puzhathi Temple, Chirakkal.P.O  
PIN 670011  
Kannur, Ph: 9895262736

**CERTIFICATE**

This is to certify that Ms. **NEESHMA P.P** M. Sc. student from Sree Narayana College, Chengannur, Kerala University carried out her M. Sc. project work on the topic **“Synthesis And Characterization Of Thin film In Effect Of cooling By SILAR Method”** under my guidance at Dept. Of Physics, Sree Narayana College, Kannur.

  
Dr. K.C. Preetha  
Associate Professor  
Department of Physics  
Sree Narayana College  
Kannur - 670 007

## ABSTRACT

In recent years, thin film science has received tremendous attention in the research area. Thin films are formed mostly by deposition either physical or chemical method. Among the chemical method of thin film deposition, the Chemical Bath Deposition (CBD) is probably the most simplest method available.

Lead sulphide(PbS) is an important narrow gap semiconductor material with an approximate energy band gap of 0.4eV at 300K and relatively large excitation Bohr radius of 18nm. These properties make PbS very suitable for Infrared detection application. This material has also been used in many fields such as photography, Pb<sup>2+</sup> ion selective sensors and solar absorption. In addition, PbS has been utilized as photo resistance, diode lasers, humidity, and temperature sensors. These properties have been correlated with the growth conditions and the nature of substrates.

This project aims the synthesis and characterization of chemically doped PbS thin film by CBD method and study the effect of cooling on this chemically deposited thin film. PbS thin film can be obtained by several methods. CBD is a very comfortable method for deposition of polycrystalline film, at low cost with a good quality of the obtained films.

# **The Problem of Missing Satellite Dwarf Galaxies: Reconciling Theory with Observations**

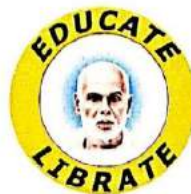
Project Report  
Submitted to the University of Kerala  
in partial fulfillment of the requirements  
for the Degree of  
Master of Science in Physics  
by

**Goutham Krishna A**  
**Reg. No:63017128002**

*Under the supervision of*  
**Dr.Anand Narayanan**  
Associate Professor  
Department of Earth and Space Science  
Indian Institute of Space Science and Technology  
Valiamala, Kerala - 695547



Department of Physics,  
Sree Narayana college,  
Chengannur  
2019







## INDIAN INSTITUTE OF SPACE SCIENCE & TECHNOLOGY

(An autonomous institution under Department of Space, Govt. of India)  
Valiamala P O, Thiruvananthapuram - 695547, Kerala, INDIA

---

August 18, 2019

Dr. Anand Narayanan  
Associate Professor  
Department of Earth & Space Sciences

Phone: (91-471) 256-8518

+91-9495960960

Email: anand@iist.ac.in

### CERTIFICATE

This is to certify that Goutham Krishna A., MSc Physics student of Sree Narayana College, Chengannur, did his final semester research project on the "**Problem of Missing Satellite Dwarf Galaxies**" under my supervision at the Indian Institute of Space Science & Technology. He has fulfilled the goals and objectives set for this project.

Anand Narayanan



## Abstract

The cold dark matter theory (CDM), which has been instrumental in explaining the formation of large scale structure of the universe “overpredicts” the number of subhalos around the Milky way galaxy. The observation gives only a few dozen dwarf galaxies around the Milkyway galaxy. The project looks into a plausible explanation for the missing dwarf satellite problem around the Milky Way galaxy.

One theory is that a significant number of subhalos never formed stars in the first place due to the heating of interstellar gas during the reionization that occurred in the early stages of the universe  $z \sim 6$  (12.8 Gyr ago). In other words, the large number of dark matter subhalos predicted by CDM models are there in the extended halo of our Galaxy, but most of them do not contain stars making them impossible to detect. In addition, there could be several dwarf galaxies around the Milky Way with an old and therefore faint stellar population formed during star formation in the early universe. These dwarf galaxies possibly could not sustain star formation due to the heating of gas from the reionization process, rendering them faint. Several of these ultra-faint dwarf galaxies (UFDs) have been identified around the Milky Way by the Sloan Digital Sky Survey.

This project is an independent reproduction of the work done by Dr. Thomas M. Brown. Using Hubble Space Telescope (HST) the photometric data of the six ultra-faint dwarfs (UFD) galaxies were taken. The stellar population in these dwarf galaxies were studied using the color-magnitude diagrams (CMD) of a significant sample of stars in each galaxy. The CMDs suggest that each of these galaxies have an aged stellar population consisting predominantly of low mass main sequence stars. A comparison of their CMDs

with the multi-band photometric data of the globular cluster M92 allows us to ascertain an age of approximately 13.2 Gyr for the galaxy's underlying stellar population. The uniformly old nature of the stellar population in this sample of UFDs support the hypothesis that the missing satellite problem for the Milky Way can be resolved by considering the suppression of star formation in dark matter in minihalos post-reionization.[3]

# Determination Of Argon Plasma Parameters Using Langmuir Probes For Electric Propulsion

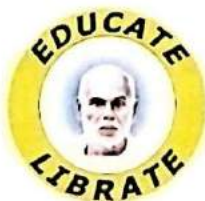
*Project Report*  
*Submitted to the University of Kerala*  
*in partial fulfillment of the requirements*  
*for the Degree of*  
**Master of Science**  
**in Physics**  
By

**Nithya P S**  
**Reg. No:63017128008**

*Under the supervision of*  
**Dr.Umesh R Kadhane**  
Head Of the Department  
Department of Physics  
Indian Institute of Space Science and Technology  
Valiamala, Kerala - 695547



Department of Physics  
Sree Narayana college, Chengannur  
2019





## भारतीय अंतरिक्ष विज्ञान एवं प्रौद्योगिकी संस्थान

(वि.अ.आयोग अधिनियम 1956 की धारा-3 के अधीन भावी मानित विश्वविद्यालय घोषित)

भारत सरकार, अंतरिक्ष विभाग, वलियमला पोस्ट, तिरुवनंतपुरम 695 547 भारत



## Indian Institute of Space Science and Technology

(A Deemed to be University u/s 3 of the UGC Act, 1956)

Government of India, Department of Space

Valiamala P.O., Thiruvananthapuram 695 547 India

www.iist.ac.in

### Certificate for M. Sc. Project work

This is to certify that Ms. Nithya P. S., M. Sc. Student from Sree Narayana College, Chengannur, Kerala University carried out her M. Sc. Project work on the topic "Determination Of Argon Plasma Parameters Using Langmuir Probes For Electric Propulsion" under my guidance at Dept. of Physics, IIST, Valiamala, Kerala. This work was done in duration from 25<sup>th</sup> March to 31<sup>st</sup> May.

During this project the student has acquired hands on experience in integrating and operating large vacuum systems and has learned vacuum technology fundamentals, ion optics, data analysis, building of sensitive electronics for extremely low current measurements. She also learned fundamental plasma physics and spectroscopy.

The student worked diligently and performed excellently well in the project work.

Dr. Umesh R. Kadhane,

Associate Professor & Head  
सह आचार्य एवं अध्यक्ष/Associate Professor & Head  
भौतिकी विभाग/Department of Physics  
भारतीय अंतरिक्ष विज्ञान एवं प्रौद्योगिकी संस्थान  
Indian Institute of Space Science and Technology  
अंतरिक्ष विभाग, भारत सरकार  
Department of Space, Government of India  
तिरुवनंतपुरम/Thiruvananthapuram-695 547

Dept. of Physics,  
IIST, Valiamala  
India



**" Non-destructive Assay of Uranium using Hybrid K-Edge/K-XRF Densitometry"**

*A Project report submitted for partial fulfilment of the requirement for the degree of*

**MASTER OF SCIENCE**

**IN**

**CHEMISTRY**

**By**

**Ms. SAYANA C**

**(Register No: 63517128010)**



**DEPARTMENT OF CHEMISTRY  
SREE NARAYANA COLLEGE  
CHENGANNUR - 689508**

## **ABSTRACT**

A hybrid K edge/K-XRF densitometry (HKED) system has been designed and fabricated for simultaneous assay of more than one actinide samples in the form of solution and powders. The system uses bremsstrahlung radiation from an X-ray generator as transmission and excitation source for K-edge densitometry and X-ray fluorescence respectively. The K edge transmitted spectral outputs for Uranium and Thorium samples, obtained from the fully fabricated set up are analysed using an ITECH quad ADC which is an embedded Linux based high performance ADC with a MCA card. This work is mainly focused on the estimation of the concentration of Uranium, Thorium individual and the mixture of Uranium & Thorium solution using HKED. The results are compared by various techniques such as gravimetric, EDXRF and potentiometric methods.

# **Naphthalimide derived arene-ruthenium complex as Theragonstic agent for cancer therapy**

A Project Report Submitted to the University of Kerala in Partial Fulfilment of  
requirements for the Degree of

**MASTER OF SCIENCE IN CHEMISTRY**

By

**NIGILA P**

**[Reg.NO-63517128008]**

**Exam code: 63516402**

**Subject code: CH243**



POST GRADUATE DEPARTMENT OF CHEMISTRY

SN COLLEGE CHENGANNUR

ALAPPUZHA

JUNE-2019

## ABSTRACT

The present study gives an overview of the progression of the use of alkyl-pyridinium derived 1, 8-naphthalimide derivatives as a photosensitizing agent and the combination of this photosensitizer with arene ruthenium (II) moiety. Mono nuclear arene ruthenium unit with N-donor ligand are known to be amphiphilic in nature due to ruggedness of the arene ruthenium unit hold them potential application as a chemotherapeutic agent. Thus these complex present a dual synergistic effect with good properties of both arene ruthenium chemotherapeutics and the alkyl –pyridinium derived 1, 8-naphthalimide photosensitizer. New ruthenium (II) arene (arene-p-cymene) combined with alkylpyridinium derivatives {2-(pyridine-4-yl) methyl or 3-yl, 2-(pyridine-4-yl) or 3-yl, 2-(pyridine-4-yl) ethyl and N, N'-dimethyl} have been synthesized characterised by spectroscopy (IR, MS, H<sup>1</sup> NMR). The photo physical and fluorescence properties of these compounds are shown to vary greatly with substitution on the amino nitrogen, and alkyl substitution on the imide nitrogen. Suggesting potential use of this structure as a Theragonstic agent.

**DEVELOPMENT OF CORIANDER LEAF BASED HERBAL TEA AND  
COMPARATIVE STUDY OF QUANTITATIVE AND ANTIOXIDANT  
ACTIVITY BETWEEN CORIANDER TEA POWDER AND  
COMMERCIAL TEA POWDER USING ETHANOL AS EXTRACT**

*A project report submitted to the University of Kerala in partial fulfillments of  
requirements for the Degree of*

**MASTER OF SCIENCE**

**IN CHEMISTRY**

**By**

**Candidate Code : 63517128004**

**Course Code : 635**

**Exam Code : 63516402**

**Subject Code : CH243**



**September 2019**



## ABSTRACT

Herbal teas have been gaining popularity as consumers believe that they are natural safe and can promote health. In the present study, coriander leaf based herbal teas were developed with the combination of supporting and activity herbs like guava leaf, dry ginger, lemon grass. The developed herbal combinations were packed as dip tea bags. Total Phenol Content (TPC), Total Tannin Content (TTC), Total Carbohydrate Content (TCC), Total Flavonoid Content (TFC), Total Antioxidant activity were investigated in coriander leaves as well as herbal combination by standard method. Result indicate that coriander leaf based herbal tea exhibit Total Phenol Content (70 mg GAE/g), Total Tannin Content (66mg TE/g), Total Flavonoid Content (44 mg QE/g), Total Carbohydrate Content (55 mg/g). There are several kinds of herbal teas that have been used for their medicinal properties. Some of them being consumed for its energizing properties to help induce relaxation to curb stomach or digestive problems and also strengthen the immune system. Demonstrating very few demerits, researchers continue to examine and vouch for the health benefits of drinking herbal teas. Based on the result of this study it can be concluded that coriander leaves have potential antioxidant activity and can be an alternative to commercial tea with various health benefits.

**"Viscosity and interfacial tension of trialkyl phosphate based solvents"**

*A Project report submitted for partial fulfilment of the requirement for the degree of*

**MASTER OF SCIENCE**

**IN**

**CHEMISTRY**

**By**

**Ms. SNEHA P V**

**(Register No: 63517128012)**



**DEPARTMENT OF CHEMISTRY  
SREE NARAYANA COLLEGE**

**CHENGANNUR - 689508**

**June 2019**

## **ABSTRACT**

In the present work, the effect of extractant concentration on the density and viscosity for tris(2-methylbutyl) phosphate (T2MBP) in *n*-dodecane (*n*-DD) based systems has been studied. The IFT values of the systems against water and 4 M HNO<sub>3</sub> has also been determined. The data has been compared with its straight chain isomer tri-*n*-amyl phosphate (TAP) and tri-*n*-butyl phosphate (TBP). Moreover, the effects of gamma irradiation on the hydrodynamic parameters of TBP, TAP and T2MBP based systems have also been examined. The variation in extraction behavior of an important fission product element, Zr(IV) with the extent of irradiation has been studied for TBP based systems.

**Keywords:** TBP; TAP; T2MBP; viscosity; density; interfacial tension; gamma irradiation

**2016-2018**

**A STUDY ON  
FINE AND ULTRAFINE PARTICLES  
OVER A COASTAL STATION**

*Dissertation submitted to the University of Kerala for the partial fulfillment  
for the award of the Degree of*

**MASTER OF SCIENCE  
IN  
PHYSICS**

By

**AJESH A**

Under the Supervision of

**Mr. SOBHAN KUMAR KOMPALLI**

Scientist, Space Physics laboratory  
Vikram Sarabhai Space Centre  
Thiruvananthapuram



**2018**

भारत सरकार  
अंतरिक्ष विभाग विक्रम साराभाई  
अंतरिक्ष केन्द्र  
तिरुवनन्तपुरम-695 022  
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**Vikram Sarabhai Space Centre**  
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तार/Gram: SPACE

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## Space Physics Laboratory

### Certificate

This is to certify that this project report entitled "A study on fine and ultrafine particles over a coastal station" submitted by Ajesh A for the partial fulfillment of the requirement for the award of the Degree of **Master of Science in Physics** has been successfully carried out at the Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram.

I express my hearty best wishes for his success in life.

*K. Sobhan Kumar* 31/5/18

Sobhan Kumar Kompalli  
Scientist  
SPL, VSSC  
Trivandrum

शोभन कुमार कोंपल्ली/Sobhan Kumar Kompalli  
वैज्ञानिक/इंजीनियर एसई/Scientist/Engineer SE  
अंतरिक्ष भौतिकी प्रयोगशाला/Space Physics Laboratory  
विक्रम साराभाई अंतरिक्ष केन्द्र/Vikram Sarabhai Space Centre  
भारतीय अंतरिक्ष अनुसंधान संगठन/Indian Space Research Organisation  
तिरुवनन्तपुरम, भारत/Thiruvananthapuram, India-695022

भारतीय अंतरिक्ष अनुसंधान संगठन



Indian Space Research Organisation



**EVALUATION OF CHARGE TRANSPORT IN DYE-  
SENSITIZED SOLAR CELLS EMPLOYING COPPER  
ELECTROLYTE**



A dissertation submitted in partial fulfilment of the requirements for the award  
of

**MASTER'S DEGREE IN PHYSICS**

**UNIVERSITY OF KERALA**

By

**SYAMIKA S**

**63016128012**

Sree Narayana College, Chengannur

Under the guidance of



**Dr. SURAJ SOMAN**

Photosciences and Photonics Section (PPS)

Chemical Sciences and Technology Division (CSTD)

CSIR-National Institute for Interdisciplinary Science and Technology

Thiruvananthapuram, Kerala, 695 019



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NATIONAL INSTITUTE FOR INTERDISCIPLINARY SCIENCE AND TECHNOLOGY

वैज्ञानिक तथा औद्योगिक अनुसंधान परिषद्

Council of Scientific and Industrial Research

इंडस्ट्रियल इस्टेट पी. ओ. पाप्पनकोड, तिरुवनंतपुरम, भारत - 695 019

Industrial Estate P.O., Pappanamcode, Thiruvananthapuram, India-695 019

## CERTIFICATE

This is to certify that Ms. Syamika S, a student of Sree Narayana College, Chengannur, University of Kerala, has carried out a project on "*Evaluation Of Charge Transport In Dye-Sensitized Solar Cells Employing Copper Electrolytes*" under my supervision in Photosciences and Photonics Section, Chemical Sciences and Technology Division (CSTD), CSIR-National Institute for Interdisciplinary Science and Technology (CSIR-NIIST). This work has not been submitted elsewhere for a degree.

Thiruvananthapuram

04/10/2018

Supervisor

Dr. Suraj Soman

Scientist,

Photosciences and Photonics Section

CSTD, CSIR-NIIST



## ABSTRACT

The photovoltaic cells or solar cells are devices that convert light energy directly to electricity by photovoltaic effect. Solar cells are classified into first, second and third generations. First and second generation solar cells are highly efficient but not cost-effective. Third generation PV technology garnered much research interest during last two decades for being low cost, ease of fabrication, possibility of integration into a variety of substrates and its capability of harnessing indoor/diffused light. Dye-sensitized solar cell (DSSC) is one of the most promising third generation photovoltaic devices, which was discovered in 1991 by Michael Gratzel and co-workers. DSSC mimics the nature's photosynthesis process. Just like chlorophyll in leaves, dyes present in DSSC absorb sun light and consequently electrons and holes are separated by the semiconductor and electrolyte respectively. DSSC performs better in indoor/diffused conditions in comparison to first and second generation solar photovoltaic technologies. Very recently alternative redox shuttles (Co, Cu etc) has fascinated researchers considering its ability to generate voltages  $>1V$  from a single junction device.

In the present work we carried out a detail study of mass transport limitations associated with copper electrolyte based DSSCs. We fabricated DSSC using  $TiO_2$  transparent layer with particle size of 20 nm and 30 nm respectively, followed by a scattering layer with particle size 400 nm. Standard organic dye LEG4 and  $[Cu(dmp)_2]^{1+/2+}$  were used as sensitizer and redox electrolyte with PEDOT as counter electrode. The photovoltaic fundamentals such as current density - voltage ( $J-V$ ), incident photon to current conversion efficiency (IPCE) and  $J_{sc}$  dependent on irradiation intensity revealed the mass transport limitations associated with  $[Cu(dmp)_2]^{1+/2+}$  redox mediator based DSSC. To investigate the extent of mass transport and its consequence; we carried out current transient measurement under one sun illumination. Further electrochemical impedance spectroscopy (EIS) was employed to investigate the charge transfer dynamics at the semiconductor/electrolyte interface.



# STUDY OF TROPICAL CYCLONE OCKHI



A dissertation submitted in partial fulfilment of the requirements for the award

of

MASTER'S DEGREE IN PHYSICS

UNIVERSITY OF KERALA

By

**ASSO P SAJI**

**63016128005**

Sree Narayana College, Chengannur

Under the guidance of

Dr. ANJALI R

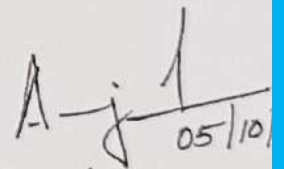
Assistant Professor

Department of Physics

NSS College, Pandalam

## CERTIFICATE

This is to certify that the project report entitled "*STUDY OF TROPICAL CYCLONE OCKHI*" is an authentic record of the project work carried out by ASSO P SAJI at the Department Of Physics, NSS College, Pandalam, under my guidance and supervision for the partial fulfilment of the requirement for the award of the degree of Master Of Science in Physics under University Of Kerala. This work has not been submitted elsewhere for a degree.

  
05/10/

Supervisor

Dr. Anjali R

Associate Professor

NSS College, Pandalam





## **ABSTRACT**

Every year during the cyclone season in India, various tropical cyclones form in the Bay of Bengal or in the Arabian Sea, bringing strong winds and heavy rains. Accurate determination of tropical cyclone motion requires accurate representation of interactions that occur throughout the depth of the troposphere on a variety of scales. Studying the trajectory of cyclones, with the help of remote sensing and satellite data will help us to know the vertical circulations as well as the dispersion of pollutants in the troposphere. Trajectory analysis of atmospheric circulations in the troposphere over a coastal site in South Kerala (Thiruvananthapuram) during one of the most devastating cyclones in India, Ockhi in November 2017 has been analyzed. Trajectory of atmospheric circulations in the troposphere during the Ockhi day and that of a normal day in November were analyzed. Back trajectory analysis were conducted in the South-West monsoon (June-August) and North-East monsoon (October-November) seasons. In order to study the impact of tropical cyclones on the air quality near the surface, Carbon monoxide vertical profile in the troposphere on the day of OCKHI and on normal days in November were also studied.

WHITE LIGHT EMISSION USING VEGETABLE  
EXTRACTS

(Project Report 2016-2018)



*Submitted to the University of Kerala in the partial  
fulfilment to the requirement for the Master's Degree of  
Science in Physics.*

*Submitted by*

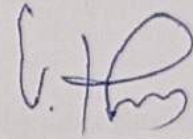
*Candidate code: 63016128004*

*Exam code: 63014403*

*Subject code: PH201*

## CERTIFICATE

Certified that this a bonafied report on the project work entitled " WHITE LIGHT EMISSION USING VEGETABLE EXTRACTS" done by Miss. ARYA RAJ under my guidance during the year 2016-2018 in partial fulfilment of the requirements for the award of the Master of Degree in Physics by the University of Kerala, Thiruvananthapuram.



Dr. Vinoy Thomas

(Department of Physics)

Christain College, Chengannur

**Dr. VINOY THOMAS**  
Assistant Professor in Physics  
Christain College  
Chengannur - 689 122  
Kerala

**Preparation and characterization of Gold  
Nanoparticles**

*Project work submitted to*

*University of Kerala, Thiruvananthapuram*

In the partial fulfillment of Requirement for the award Degree of  
Master of Science in Physics

**ANANYA B .S.**

**Reg: 63016128002**

Sree Narayana College Chengannur

Under the Guidance of

**Dr. Chandrasekharan k**

Department of science, NIT Calicut

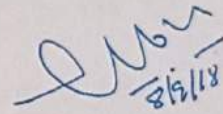


## CERTIFICATE

This is to certify that the thesis entitled "*Preparation and Characterization of Gold Nanoparticle*" submitted by Ms Ananya B S to Sree Narayana College Chengannur towards partial fulfillment of requirements for the award of degree of Master of Science (MSc) in Physics is a benefited record of work carried out by her under my supervision and guidance

Place: NIT-Calicut

Date: 8/9/18



Signature

Dr. Chandrasekharan. K  
Professor  
Department of Physics  
National Institute of Technology  
Calicut - 673601, Kerala



## ABSTRACT

Gold nanoparticles were prepared by liquid phase pulsed laser ablation technique. The size and spherical shape of the nanoparticle was verified from the TEM image. Absorption studies were conducted to characterize the absorption peak. Nonlinear absorption coefficient and nonlinear refractive index were measured using Z-scan setup. A Q switched Nd:YAG laser of wavelength 532 nm was used. The experiments were performed with Nd: YAG laser pulses.

**PREPARATION AND CHARACTERIZATION OF BISMUTH  
TELLURIDE/ FUSED THIOPHENE POLYMER FOR  
THERMOELECTRIC APPLICATIONS**



A report submitted in partial fulfillment of the requirements for the award of  
MASTER'S DEGREE IN PHYSICS  
UNIVERSITY OF KERALA

By

**ANJALY S.J.**

**63016128003**

Sree Narayana College, Chengannur

Under the guidance of

**Dr. BISWAPRIYA DEB**



Photosciences and Photonics Section (PPS)  
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इस्ट्रियल इस्टेट पी. ओ. पाप्पनकोड, तिरुवनंतपुरम, भारत - 695 019 | Industrial Estate P.O., Pappanamcode, Thiruvananthapuram, India-695 019

**CERTIFICATE**

This is to certify that Ms. Anjaly S J (Reg.No: 63016128003) of the Department of Physics, Sree Narayana College Chengannur , Kerala has carried out her project work on ***“Preparation and characterization of Bismuth Telluride/ Fused Thiophene Polymer for Thermoelectric Applications”*** under my supervision and the co-supervision of Vijitha I in partial fulfilment of the requirements for the award of the degree of MSc Physics, from University of Kerala. The work was carried out at the Photoscience and Photonics Section, Chemical Science and Technology Division, CSIR-National Institute for Interdisciplinary Science and Technology, Thiruvananthapuram, during the period April to June 2018. The present work or any part thereof has not been submitted elsewhere for a degree.

Vijitha I

Senior Research Fellow

Dr. Biswapriya Deb

Senior Scientist



डॉ. बिष्वाप्रिया देब / Dr. BISWAPRIYA DEB  
वरिष्ठ वैज्ञानिक / Senior Scientist  
रासायन विज्ञान तथा प्रौद्योगिकी प्रभाग  
Chemical Sciences & Technology Division  
सी एस आई आर - राष्ट्रीय अंतर्विषयी विज्ञान तथा प्रौद्योगिकी संस्थान  
CSIR-National Institute for Interdisciplinary  
Science & Technology (NIIST), Govt. of India  
तिरुवनन्तपुरम / Thiruvananthapuram-695 019, Kerala



## ABSTRACT

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With looming energy crisis, harvesting waste heat to produce electricity has recently garnered wide spread attention. Particularly, hot water released by the industries, automotive exhaust and high temperature industrial processing are the major waste heat sources; a conversion of which could ensure significant social benefits by producing clean energy and reducing fuel cost. Thermoelectric materials, which can convert heat into electricity and electricity into heat, hold promise for turning waste heat into power. The thermoelectric modules are solid-state devices, therefore have no moving parts and are silent, reliable, lightweight and durable. However, thermoelectric modules consisting of inorganic materials are generally heavy, cumbersome, and can have limited scalability because of the price of materials or processing techniques. Polymer nanocomposites based thermoelectric materials are a new class of functional materials that have immense potential for waste heat utilization, power generation and micro-refrigeration at commercial scale. Devices based on these materials typically operate  $< 350\text{ }^{\circ}\text{C}$  and could be used for on-the-spot sustainable power generation from thermal sources like hot water released by process plants, automotive exhausts, and even human/mammal body heat.

In this project a hybrid thermoelectric material of fused thiophene-based polymer with bismuth telluride nanoparticles was developed and which displays a highly encouraging thermoelectric performances. The identified hybrid composite has been modified by doping with an inorganic oxidizing agent, ferric chloride and gold nanoparticle to improve the thermoelectric properties. The effect of doping in structure and morphology of the hybrid composite were studied using X-ray diffraction (XRD), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), and Atomic force microscopy (AFM) techniques.

**A STUDY OF PHASE TRANSITION OF  
TRANSVERSE ISING MODEL USING ENERGY GAP**



Post Graduate Department of Physics

**SREE NARAYANA COLLEGE**

**CHENGANNUR**

Affiliated to University of Kerala, India.

*Dissertation submitted to the University of Kerala for the partial fulfilment for the award of  
degree of*

**MASTER OF SCIENCE IN PHYSICS**

*By*

**SHIBU A S**

*Under the guidance of*

**DR.UMA DIVAKARAN**

**ASSISTANT PROFESSOR**

**INDIAN INSTITUTE OF TECHNOLOGY**

**PALAKKAD, KERALA.**



DEPARTMENT OF PHYSICS  
INDIAN INSTITUTE OF TECHNOLOGY  
PALAKKAD, KERALA.

CERTIFICATE

This is to certify that Mr. SHIBU.A.S, Reg.No.63016128010 has worked on the project entitled "A STUDY OF PHASE TRANSITION OF TRANSVERSE ISING MODEL USING ENERGY GAP" under my supervision and guidance during the year 2017-2018 in the Department of Physics, IIT Palakkad, Kerala.

*Uma*  
*1/11/2018*

DR.UMA DIVAKARAN  
(Assistant Professor)

DEPARTMENT OF PHYSICS  
INDIAN INSTITUTE OF TECHNOLOGY  
PALAKKAD, KERALA

डा. उमा दिवाकरन Dr. UMA DIVAKARAN  
Assistant Professor  
IIT Palakkad - 678 557  
Phone : 04923 - 226321, Mail : uma@iitpkd.ac.in