

***Glycosmis pentaphylla*-Derived Carbon Quantum Dots for Highly Selective and Sensitive Detection of Ciprofloxacin**

A Dissertation submitted in partial fulfilment of the requirements for the award of the Degree of

Master of Science in Chemistry

By

AKSHAYA RAMACHANDRAN

(CCAWMCH015)

Submitted to

THE DEPARTMENT OF CHEMISTRY



CHRIST COLLEGE AUTONOMOUS IRINJALAKUDA, 680125

Under the guidance of

Dr. BEENA MATHEW



SCHOOL OF CHEMICAL SCIENCES

MAHATMA GANDHI UNIVERSITY

KOTTAYAM, KERALA

JULY 2024



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DECLARATION

I hereby declare that the dissertation entitled “*Glycosmis pentaphylla-Derived Carbon Quantum Dots for Highly Selective and Sensitive Detection of Ciprofloxacin*” is the original work done by me, under the supervision and guidance of **Dr. Beena Mathew**, Senior Professor, School of Chemical Sciences, Mahatma Gandhi University, Kottayam, in partial fulfilment of the requirements for the award of the degree of Master of Science in Chemistry of Calicut University. No part of this dissertation has been presented earlier to award any degree, diploma, or other titles of recognition.

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ACKNOWLEDGEMENT

At the very outset of this report, I would like to extend my sincere obligation to all the persons who have helped me in this endeavour. Without their active guidance, help, cooperation, and encouragement, I would not have made headway in the project.

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*I express my gratitude to our Head of the Department, **Dr. Greeni K I** for providing an opportunity to do the project work.*

*I express my heartfelt gratitude to my external supervisor **Dr. Beena Mathew**, Senior Professor, School of Chemical Sciences, Mahatma Gandhi University, Kottayam, Kerala, for allowing me to do my M.Sc. project under her supervision. I thank her for her guidance, continued assistance, encouragement, and involvement throughout my research work.*

*I am grateful to **Dr. Anitha C Kumar**, former Director, School of Chemical Sciences, Mahatma Gandhi University, Kottayam, Kerala, for permitting me and providing the necessary facilities for this work. I also take this opportunity to thank all the other teaching and non-teaching members of the School of Chemical Sciences for their help and support.*

*I sincerely thank **Ms. Jincy Mathew** and **Ms. Neena John Plathanam** Research Scholars, School of Chemical Sciences, Mahatma Gandhi University, Kottayam, Kerala, for their great support, guidance, and timely assistance during my project work.*

I am also greatly obliged to all members of the Department of Chemistry for their valuable suggestions, support, and inspiration which have enabled me to complete it successfully.

I also acknowledge with a deep sense of reverence, my gratitude towards my parents and members of my family, who has always supported me morally as well as economically.

Last but not least gratitude goes to all of my friends, who directly or indirectly helped me to complete this project report.

AKSHAYA RAMACHANDRAN

ABSTRACT

In the current study, we used the leaves of *Glycosmis pentaphylla* as the carbon source to synthesize carbon quantum dots (CDs) utilising a one-step hydrothermal process without the use of extra chemical reagents or functionalization. Under UV light, the CDs fluoresced blue as they were being created. They have surface functional groups like carboxyl and hydroxyl groups, are biocompatible, have high fluorescence, and are well soluble in water. Ciprofloxacin has been shown to enhance the luminous intensity of CDs, and a linear association between fluorescence intensity and ciprofloxacin concentration was seen over a wide range of concentrations. These outstanding qualities make the CDs suitable for use in biomedical fields.

Keywords: Carbon quantum dots, sensing, ciprofloxacin, fluorescence enhancement, drugs

***Muehlenbeckia platyclada* Derived Carbon Quantum Dots for the Highly Selective and Sensitive Detection of Ciprofloxacin**

A Dissertation submitted in partial fulfilment of the requirements for the award of the Degree

of

Master of Science in Chemistry

By

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Submitted to



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DECLARATION

I hereby declare that the dissertation entitled “*Muehlenbeckia platyclada* Derived Carbon Quantum Dots for the Highly Selective and Sensitive Detection of Ciprofloxacin” is the original work done by me, under the supervision and guidance of **Dr. Beena Mathew**, Senior Professor, School of Chemical Sciences, Mahatma Gandhi University, Kottayam, in partial fulfilment of the requirements for the award of the degree of Master of Science in Chemistry of Calicut University. No part of this dissertation has been presented earlier to award any degree, diploma, or other titles of recognition.

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ACKNOWLEDGEMENT

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In the current study, we used the leaves of *Muehlenbeckia platyclada* as the carbon source to synthesize carbon quantum dots (CQDs) utilizing a one-step hydrothermal process without the use of extra chemical reagents or functionalization. Under UV light, the CQDs fluoresced blue as they were being created. They have surface functional groups like carboxyl and hydroxyl groups are biocompatible, have high fluorescence, and are well soluble in water. Ciprofloxacin has been shown to enhance the luminous intensity of CQDs, and a linear association between fluorescence intensity and ciprofloxacin concentration was seen over a wide range of concentrations. These outstanding qualities make the CQDs suitable for use in biomedical fields.

Keywords: Carbon quantum dots, sensing, ciprofloxacin, fluorescence enhancement, drugs

**ELECTRO- ORGANIC SYNTHESIS OF N-PHENYL
PYRROLE AND (PHENYL ETHYNYL) COPPER(I)**

A dissertation submitted to
UNIVERSITY OF CALICUT
in partial fulfilment of the requirement for Degree of
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Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

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DECLARATION

I hereby declare that the dissertation entitled “**ELECTRO-ORAGANIC SYNTHESIS OF N-PHENYL PYRROLE AND (PHENYL ETHYNYL COPPER(I))**” an authentic record of the project work carried out by me under the guidance and supervision of Dr. Ditty Dixon Associate Professor, School of Chemical Science, Mahatma Gandhi University, Kottayam. It has not formed the part of any other thesis submitted for the award of any Degree/Diploma Associateship/ Fellowship or similar title to any candidate of any University.

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I would like to take the opportunity to thank all friends and lab mates for their help and motivation. Finally, I would also express my sincere gratitude to my parents, for their encouragement and support throughout. Once again, I thank each and every person who was of great support in deliberating over the problems and findings throughout my dissertation.

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ABSTRACT

Electro-organic synthesis has received increasing attention due to growing need to develop safe and environmentally friendly synthesis for organic molecules. In conventional organic synthesis the energy is supplied to reactant molecules as thermal energy via heating, but this method has higher energy loss. In electro-organic synthesis this energy source is replaced by electric current which is a reliable source of energy. This study is the electro-organic synthesis of N-Phenyl Pyrrole and (Phenyl ethynyl) Copper (I). The synthesis of N-Phenyl Pyrrole is done by Linear Sweep Voltammetry and confirmed by GC-MS and NMR Spectrum. The of (Phenyl Ethynyl) Copper(I) is done by chronoamperometry and confirmed by FT-IR

SYNTHESIS OF LIGNIN GELATINE BIOFILM WITH TANNIC ACID AS CROSSLINKING AGENT FOR FOOD PACKAGING APPLICATIONS

A dissertation submitted to the **University of Calicut** in partial fulfilment of the requirement for the degree of **Master of Science in chemistry**

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This is to certify that the dissertation entitled “**Synthesis of lignin gelatin biofilm with tannic acid as crosslinking agent for food packaging applications**” is an authentic record of work carried out by **ANN MARIYA K P (Reg No: CCAWMCH018)** under the guidance of **Dr. Saritha A, Associate Professor, Amrita VishwaVidyapeetham, Amritapuriduring** the period of April 2024 to June 2024 as partial fulfilment of the requirement for the degree of master of science in chemistry. Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

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Ms Krishnapriya K M

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DECLARATION

I hereby declare that the dissertation entitled “**Synthesis of lignin gelatin biofilm with tannic acid as crosslinking agent for food packaging applications**” being submitted to university of Calicut in partial fulfilment of the requirement for degree of Master of Science in Chemistry is a bonafide record of research work done by me under the guidance of Dr. Saritha A, Associate Professor, Amrita VishwaVidyapeetham, Amritapuri. It has not formed the part of any other thesis submitted for the award of any Degree/Diploma Associateship/ Fellowship or similar title to any candidate of any University.

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ANN MARIYA K P

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I express my sincere thanks to **Dr. Saritha A, Associate Professor, AmritaVishwaVidyapeetham, Amritapuri** for giving me the wonderful opportunity to work in her lab. The valuable suggestions provided were of immense help throughout my project work and crafted an extremely knowledgeable experience for me. Without her guidance and persistent help, the completion of this project would not have been possible.

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ANN MARIYA K P

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**Influence of the A site composition fluctuations on the
properties of high T_C 0.36BiScO_3 - 0.64PbTiO_3 based
piezoceramics**

*A dissertation Submitted in partial fulfilment of the requirements for the degree
of*

Master of science

In

Chemistry

By

Anugraha C R

REG NO. CCAWMCH019

Under the guidance of

Dr. Karthik T

Scientist D

**Centre materials for electronics technology (CMET),
Thrissur**



Submitted to Christ college (Autonomous)

Affiliated to

University of Calicut



CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA
DEPARTMENT OF CHEMISTRY

CERTIFICATE

This is to certify that the dissertation entitled “**Influence of the A site composition fluctuations on the properties of high T_C 0.36BiScO_3 - 0.64PbTiO_3 based piezoceramics**” is an authentic record of work carried out by **Ms. ANUGRAHA C R (Reg No: CCAWMCH019)** under the guidance of **Dr. Karthik T Scientist D Centre materials for electronics technology (CMET) Thrissur**, from April 2024 to June 2024 in partial fulfillment of the requirement for the award of Master of Science in Chemistry.

Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

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This is to certify that **Ms.Anugraha C.R**, Post graduate student of **Christ College (Autonomous),Irinjalakuda, Calicut University** has carried out her project work titled“**Influence of the A Site Composition fluctuations on the properties of high T_c BiScO₃-PbTiO₃ based Piezoceramics**”,under my supervision for the partial fulfilment of award of degree of Master of chemistry, at **CENTRE FOR MATERIALS FOR ELECTRONICS TECHNOLOGY (C-MET),THRISSUR** during the period of April 2024 to June 2024 .

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CERTIFICATE

This is to certify that the dissertation entitled “**Influence of the A Site Composition fluctuations on the properties of high T_c BiScO₃-PbTiO₃ based Piezoceramics**” submitted to the University of Calicut in partial fulfillment of the degree of Master of Science in Chemistry is a bona fide record of work carried out by **Ms.ANUGRAHA C R** . This dissertation was guided and written under my supervision.

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Declaration

I, Anugraha C.R, Register No:CCAWMCH019, do hereby declare that this project entitled “**Influence of the A site composition fluctuations on the properties of high T_C $0.36\text{BiScO}_3\text{-}0.64\text{PbTiO}_3$ based piezoceramics**” submitted to Christ college (Autonomous) Irinjalakuda affiliated to **university of Calicut** in the partial fulfillment of requirements for the award of the degree of **Master of Science in Chemistry**, is a bonafide record of work and investigations carried out by me under the guidance and supervision of **Dr. Karthik T**, Scientist-D, C-MET, Thrissur, during the academic year 2022-2024. This dissertation has not been submitted to any university for the award of any degree or in any other title of recognition.

Place: Thrissur

Anugraha C R

June 2024

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I use this opportunity to express my profound gratitude and regards to my supervisor of this work **Dr. Karthik T**, Scientist-D, Centre for Materials for Electronics Technology (C-MET), Thrissur for giving me the opportunity to do my project and providing invaluable guidance throughout this work. Without his support and encouragement, I couldn't have completed this project successfully.

I also express my gratitude to **Mrs. Greeni K I**, HOD, Department of Chemistry, Christ college (Autonomous) Irinjalakuda affiliated to university of Calicut for her support and motivation. I am obliged to the faculty of Department of Chemistry, Christ college (Autonomous) for the kind consideration throughout the work.

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ANUGRAHA C R

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**SYNTHESIS AND CHARACTERISATION
OF NICKEL COBALTITE
FOR SUPERCAPACITOR APPLICATIONS**

PROJECT REPORT SUBMITTED TO THE
UNIVERSITY OF CALICUT
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR
THE AWARD OF THE DEGREE OF
MASTER OF SCIENCE

**IN
CHEMISTRY**

BY

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DEPARTMENT OF CHEMISTRY

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This is to certify that the dissertation entitled “**SYNTHESIS AND CHARACTERIZATION OF NICKEL COBALTITE FOR SUPERCAPACITOR APPLICATIONS**” is an authentic record of work carried out by **Ms. APARNA PR (Reg No: CCAWMCH020)** under the guidance of **Ms. RANI PANICKER N, SCIENTIST, C-MET, THRISSUR**, from April 2024 to June 2024 in partial fulfillment of the requirement for the award of Master of Science in Chemistry.

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This is to certify that the dissertation entitled “**SYNTHESIS AND CHARACTERIZATION OF NICKEL COBALTITE FOR SUPERCAPACITOR APPLICATIONS**” submitted to the University of Calicut in partial fulfillment of the degree of Master of Science in Chemistry is a bonafide record of work carried out by **Ms. APARNA PR.** This dissertation was guided and written under my supervision.

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I, APARNA P R of Department of Chemistry, Christ College (Autonomous) Irinjalakuda hereby declare that the work described in this report entitled **“SYNTHESIS & CHARACTERIZATION OF NICKEL COBALTITE FOR SUPERCAPACITOR APPLICATIONS,”** is the result of the investigations carried out by me at the Centre for Materials for Electronics Technology (C-MET), Thrissur, under the supervision of Ms.Rani Panicker N, Scientist, C-MET, Thrissur.

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**SYNTHESIS AND CHARACTERIZATION OF ZINC OXIDE AND
CHITOSAN-ZINC OXIDE COMPOSITES, AND THEIR APPLICATION IN THE
PHOTOCATALYTIC DEGRADATION OF ORGANIC DYES**

A dissertation submitted to

UNIVERSITY OF CALICUT

in partial fulfillment of the requirement for Degree of
Master of Science in Chemistry

By

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This is to certify that the dissertation entitled “**Synthesis and characterization of zinc oxide and chitosan-zinc oxide composites, and their application in the photocatalytic degradation of organic dyes**” submitted to the faculty of science University of Calicut in partial fulfillment of the degree of Master of Science in Chemistry is a bonafide record of work carried out by **JIYA K J** .This dissertation was guided and written under my supervision.

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DECLARATION

I hereby declare that the project entitled “**synthesis and characterization of zinc oxide and chitosan-zinc oxide composites, and their application in the photocatalytic degradation of organic dyes**” is a bonafide work done by me, under supervision of Dr. Jorphin Joseph, Department Of Chemical Oceanography , Cochin University of Science and Technology, Kochi, in partial fulfillment for the award of degree of M.Sc. Chemistry. I also affirm that this work has not been submitted before for the award of any degree or diploma elsewhere.

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LEAD FREE MANGANESE BASED PEROVSKITE NANO CRYSTALS FOR THE FLUORESCENCE 'SWITCH OFF' DETECTION OF TNP

A dissertation submitted to

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Master of Science in Chemistry

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This is to certify that the dissertation entitled “**LEAD FREE MANGANESE BASED PEROVSKITE FOR THE FLUORESCENCE ‘SWITCH OFF’ DETECTION OF TNP**” is an authentic record of the research work carried out by **Jiya Shaju** under my supervision and guidance at the Department of Chemistry, School of Physical and Mathematical Science, University of Kerala, Kariavattom, Thiruvananthapuram, during April 2024-June 2024, in partial fulfilment of the requirement for the degree of Master of Science in Chemistry, and no part of this dissertation has been presented before for any other degree.

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I hereby declare that the dissertation entitled “**LEAD FREE MANGANESE BASED PEROVSKITE FOR THE FLUORESCENCE ‘SWITCH OFF’ DETECTION OF TNP**” being submitted to University of Calicut in partial fulfillment of the requirement for degree of Master of Science in chemistry is a bonafide record of research work done by me under the guidance of Dr. SONY GEORGE, Assistant Professor, Department of Chemistry, University of Kerala, Kariavattom. It has not formed the part of any other thesis submitted for the award of any Degree/Diploma Associateship/Fellowship or similar title to any candidate of any University.

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**ELECTROSPUN POLYVINYLIDENE
FLUORIDE/ALUMINUM NITRIDE POLYMER
NANOCOMPOSITES FOR ENERGY HARVESTING**

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by

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This is to certify that the dissertation entitled “**Electrospun Polyvinylidene Fluoride/Aluminum Nitride Polymer Nanocomposites for Energy Harvesting**” is an authentic record of work carried out by **Ms. KEERTHANA SURESH (Reg No: CCAWMCH023)** under the guidance of **Dr. SONEY VARGHESE, Professor, Nanomaterials and Devices Research Laboratory, Department of Materials Science and Engineering, National Institute of Technology Calicut**, from 1st April 2024 to 31st May 2024 as partial fulfillment of the requirement for the award of Master of Science in Chemistry.

Certified further to the best of our knowledge that this does not form part of any other dissertation or project work based on which a degree or diploma or a similar title has been awarded earlier to any candidate by any other university.

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DECLARATION

I hereby declare that the dissertation entitled “**Electrospun Polyvinylidene Fluoride/Aluminum Nitride Polymer Nanocomposites for Energy Harvesting**” an authentic record of the project work carried out by me under the guidance and supervision of **Dr. SONEY VARGHESE, Professor, Nanomaterials and Devices Research Laboratory, Department of Materials Science and Engineering, National Institute of Technology Calicut**, in partial fulfillment of the requirement for the award of the degree of M.Sc. Chemistry. The contents of this work are original and have not been submitted in whole or in part for consideration for any other degree or qualification in this, or any other university. It does not contain any outcome of work done in collaboration with others, except as specified in the text and acknowledgments.

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KEERTHANA SURESH

ABSTRACT

The synthesis of PVDF nanofibers and their application in various fields through the utilization of their piezoelectric behavior are highlighted in this work. Piezoelectric properties in PVDF have attracted more interest due to AlN's ability to enhance the piezoelectricity and promote the production of the β phase content. Only the β phase has good electricity. This study used two processes to create lightweight polymer composites based on PVDF-AlN: solution-casting and electrospinning methods. The electrospun PVDF nanofiber film with different compositions of AlN achieved a high β -phase concentration, increasing the piezoelectric output voltage of PVDF/AlN nanofiber film-based piezoelectric nanogenerators (PNG). A device with 1 wt% PVDF/AlN composite was fabricated, resulting in a higher output voltage of 2 V than pure PVDF fiber. The device is tested by using finger tapping to generate electrical energy. The study aims to explore the use of piezoelectric devices for energy storage. The characterization analysis used SEM, XRD, FT-IR, and Raman spectroscopy. The results showed promising potential for utilizing piezoelectric devices in energy storage applications. Further research is needed to optimize the performance and efficiency of these devices for practical implementation.

Keywords: polymer nanocomposites, PVDF, AlN, piezoelectric, energy harvesting

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**SYNTHESIS AND CHARACTERIZATION OF ZnO-Co₃O₄
GREEN COMPOSITE PIGMENTS**

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This is to certify that the dissertation entitled “**SYNTHESIS AND CHARACTERIZATION OF ZnO-Co₃O₄ GREEN COMPOSITE PIGMENTS**” submitted to the University of Calicut in partial fulfillment of the degree of Master of Science in Chemistry is a bona fide record of work carried out by **Ms. NAMITHA HYDROSE**. This dissertation was guided and written under my supervision.

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DECLARATION

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27-07-2024

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*I would like to express my deepest gratitude to everyone who contributed to the completion of this project. It gives me immense pleasure to express my deep sense of gratitude to my project guide **Dr. Abraham Joseph**, Senior Professor, Department Of Chemistry, University Of Calicut; for his invaluable guidance, support, and expertise throughout this project.*

*My sincere appreciation goes out to my co-guide, **Dr. Anupama R Prasad**, Research Associate, Christ College (Autonomous), Irinjalakuda; for introducing me to my project guide and for her unwavering support and guidance at every turn to ensure the work is completed satisfactorily. Despite her demanding schedule, she guided me through the entire project, which I am really grateful for.*

I am grateful to the University of Calicut for providing me an opportunity to carry out the research project.

*I would like to thank **Ms. Greeni K I**, the coordinator of M.Sc. Chemistry, Christ College (Autonomous), Irinjalakuda; for her guidance and support. I sincerely appreciate the guidance that I have received from my internal guide, **Dr. Shereema R M**, and the other faculty members of the department.*

*I would also like to thank the Ph.D. research scholars **Ms. Athira Ajayan**, **Ms. Anupriya K**, **Ms. Sreelakshmi T**, **Ms. Anila Paul**, **Ms. Vismaya Joseph**, and **Ms. Arunima K K** for providing me the necessary resources as well as valuable insights and feedback that improved the quality of my research project.*

I would also like to thank my family and friends for their unwavering support. Finally, I would like to thank everyone who assisted me with this dissertation.

NAMITHA HYDROSE

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***Tabernaemontana divaricata* Derived Carbon Quantum Dots for the Highly Selective and Sensitive Detection of Phenylalanine**

*A Dissertation submitted in partial fulfilment of the requirements
for the award of the Degree of*

Master of Science in Chemistry

By

NIVEDYA N

(CCAWMCH025)

Submitted to

THE DEPARTMENT OF CHEMISTRY

CHRIST COLLEGE AUTONOMOUS IRINJALAKUDA, 680125



Under the guidance of

Dr. BEENA MATHEW



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DECLARATION

I hereby declare that the dissertation entitled “*Tabernaemontana divaricata Derived Carbon Quantum Dots for the Highly Selective and Sensitive Detection of Phenylalanine*” is the original work done by me, under the supervision and guidance of **Dr. Beena Mathew**, Senior Professor, School of Chemical Sciences, Mahatma Gandhi University, Kottayam, in partial fulfilment of the requirements for the award of the degree of Master of Science in Chemistry, Christ College (Autonomous) Irinjalakuda. No part of this dissertation has been presented earlier to award any degree, diploma, or other titles of recognition.

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**SYNTHESIS, CHARACTERIZATION AND SENSING
APPLICATIONS OF PANI-PVP COMPOSITES**

*A dissertation submitted to the University of Calicut in partial fulfillment
of the requirements for the award of the degree of*

MASTER OF SCIENCE IN CHEMISTRY

By

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*I would like to express my deepest gratitude to everyone who contributed to the completion of this project. It gives me immense pleasure to express my deep sense of gratitude to my project guide **Dr. Abraham Joseph**, Senior Professor, Department Of Chemistry, University Of Calicut; for his invaluable guidance, support, and expertise throughout this project.*

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*I would also like to thank the Ph.D. research scholars **Ms. Athira Ajayan**, **Ms. Anupriya K**, **Ms. Sreelakshmi T**, **Ms. Anila Paul**, **Ms. Vismaya Joseph**, and **Ms. Arunima K K** for providing me the necessary resources as well as valuable insights and feedback that improved the quality of my research project.*

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SYNTHESIS AND STUDIES ON PORPHYRIN BASED CHIRAL MACROCYCLES

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CERTIFICATE

This is to certify that the dissertation entitled “**Synthesis and Studies on Porphyrin-based Chiral Macrocycles**” is the bonafide work of **SREELAKSHMI K P** who carried out the dissertation work under my supervision at **Indian Institute of Science Education and Research (IISER)**, Thiruvananthapuram, Kerala, during April 2024-June 2024. To the best of my knowledge, the work reported by her, does not be a part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any scholar.

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DECLARATION

I hereby declare that the dissertation entitled “**Synthesis and Studies on Porphyrin-based Chiral Macrocycles**” being submitted to university of Calicut in partial fulfilment of the requirement for degree of Master of Science in Chemistry is a bonafide record of research work done by me under the guidance of Dr. Soumen De, Asst. Professor School of Chemistry, IISER Thiruvananthapuram. It has not formed the part of any other thesis submitted for the award of any Degree/Diploma Associateship/Fellowship or similar title to any candidate of any University.

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**GRAPHENE BASED NICKEL CATALYST FOR
HYDROGEN EVOLUTION REACTION IN ALKALINE
MEDIUM**

*A dissertation submitted to the University of Calicut in partial fulfillment
of the requirements for the award of the degree of*

MASTER OF SCIENCE IN CHEMISTRY

By

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This is to certify that the dissertation entitled “**GRAPHENE BASED NICKEL CATALYST FOR HYDROGEN EVOLUTION REACTION IN ALKALINE MEDIUM**” submitted to the Christ College (Autonomous), Irinjalakuda, in partial fulfillment of the degree of Master of Science in Chemistry is a bona fide record of work carried out by **Ms. SUMAYYA M S**. This dissertation was guided and written under my supervision.

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DECLARATION

I, **SUMAYYA M S**, hereby declare that the dissertation, entitled **“GRAPHENE BASED NICKEL CATALYST FOR HYDROGEN EVOLUTION REACTION IN ALKALINE MEDIUM”** is a bona fide record of project work done by me under the supervision and guidance of **Ms.GREENI KI**, coordinator, Department of Chemistry, Christ College (Autonomous), Irinjalakuda, and it has not formed the basis for the award of any Degree/Diploma/Associate ship/Fellowship or other similar title to any University.

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