This thesis is dedicated

to

my beloved

Ammu and Sister

Statement by author

This dissertation has been presented to meet the partial requirements for the attainment of an advanced degree at the University of North Bengal (NBU) and has been deposited in the library for lending under the regulations of the NBU. Brief excerpts from this dissertation may be used without special permission, provided proper acknowledgment of the source is made. Requests for permission to reproduce or quote extensively from this manuscript, in whole or in part, may be granted by the authorized personnel of NBU if deemed beneficial for academic purposes. Otherwise, permission must be sought from the author.

Ziaur Rahman

Declaration

I hereby declare that this thesis entitled **"Photophysical and sensorial behavior of different chromophoric systems comprising electron donor-acceptor units"** embodies my original research work, conducted under the supervision of Dr. Sudhir Kumar Das, at the Department of Chemistry, University of North Bengal.

The work presented in this thesis results from my independent investigation and reflects my efforts and understanding of the subject matter. All the data, results, and conclusions presented in this document are based on genuine research findings and have not been previously submitted for any other degree or qualification at this or any other institution.

I affirm that the content of this thesis is the result of my research work and is presented with utmost honesty and integrity.

Ziaur Rahman

Ziaur Rahman
Department of Chemistry
University of North Bengal
Darjeeling-734013
West Bengal, India

Date: 05.12.2023

UNIVERSITY OF NORTH BENGAL

Dr. Sudhir Kumar Das, Ph. D
Assistant Professor
Department of Chemistry
North Bengal University
Darjeeling, 734013

Email: sudhirkumardas@nbu.ac.in
Mobile: 91-8016884965

"समानो मन्त्र समिति समानी"

Accredited by NAAC with Grade B++

Certificate

I certify that Mr. Ziaur Rahman has prepared the thesis entitled **"Photophysical and sensorial behavior of different chromophoric systems comprising electron donor-acceptor units"** for the award of Ph.D. degree of the University of North Bengal, under my guidance. He has carried out the research work at the Department of Chemistry, University of North Bengal.

05/12/2023

Dr. Sudhir Kumar Das
Assistant Professor
Department of Chemistry
North Bengal University
Darjeeling, 734013
West Bengal, India

Dr. Sudhir Kumar Das
Assistant Professor
Department of Chemistry
University of North Bengal
Darjeeling - 734013, India

Antiplagiarism report

DrillBit

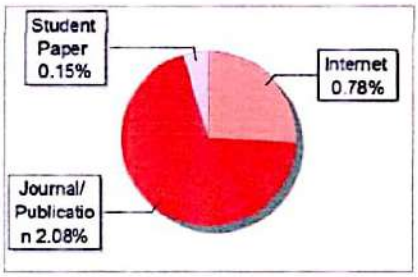
The Report is Generated by DrillBit Plagiarism Detection Software

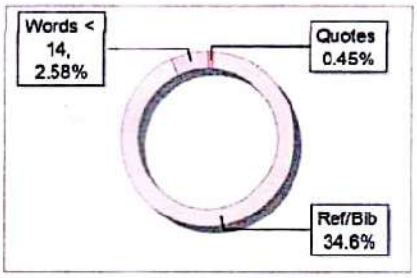
Submission Information

Author Name	Ziaur Rahman
Title	Photophysical and sensorial behavior of different chromophoric systems comprising electron donor-acceptor units
Paper/Submission ID	1119764
Submitted by	nbuplg@nbu.ac.in
Submission Date	2023-11-21 13:55:34
Total Pages	120
Document type	Thesis

Result Information

Similarity **3 %**





Exclude Information

Quotes	Excluded
References/Bibliography	Excluded
Sources: Less than 14 Words Similarity	Not Excluded
Excluded Source	2 %
Excluded Phrases	Not Excluded

05/12/2023

Dr. Sudhir Kumar Das
Assistant Professor
Department of Chemistry
University of North Bengal
Darjeeling - 734013, India

Ziaur Rahman
05/12/2023

Preface

It is with great pleasure and a sense of profound accomplishment that I present this thesis, titled "**Photophysical and sensorial behavior of different chromophoric systems comprising electron donor-acceptor units**," as a culmination of my journey towards obtaining a Doctor of Philosophy (Ph.D.) degree in Chemistry. This research work reflects the dedicated efforts and unyielding passion that have driven me throughout my academic pursuit.

My registration for the Ph.D. program at the University of North Bengal commenced on 2nd January 2020, vide letter no. Ph.D./Chem. (1723)/627/R-2023, under the esteemed guidance of Dr. Sudhir Kumar Das. I embarked on this scholarly endeavor to explore the intriguing realm of photophysical and sensorial properties of diverse chromophoric systems that incorporate electron donor-acceptor units.

The motivation behind this research stemmed from the ever-growing interest in understanding the interactions between electron donor and acceptor moieties within molecular systems and their profound influence on photophysical phenomena and sensorial responses. These chromophoric systems exhibit intriguing properties that have the potential for various applications, such as organic photovoltaics, light-emitting devices, and molecular sensors. Unlocking the underlying mechanisms governing their behavior and exploring their potential in real-world applications has driven this investigation.

I am deeply indebted to my esteemed supervisor, Dr. Sudhir Kumar Das, whose profound knowledge, expertise, and guidance have been instrumental in shaping the direction of this research. His constant encouragement, valuable insights, and constructive feedback have been the guiding beacons that illuminated my path during moments of uncertainty.

I also extend my heartfelt gratitude to the Department of Chemistry at the University of North Bengal for providing a nurturing academic environment and access to state-of-the-art facilities, which proved essential in conducting this research.

Acknowledgments

I sincerely thank **Dr. Sudhir Kumar Das**, my supervisor, for his invaluable scientific assistance and unwavering support throughout my research. His extensive knowledge and passion for science have been a constant source of inspiration, motivating me to excel in the laboratory. I feel privileged to have worked with him and appreciate his patience in critically reviewing this thesis.

I sincerely thank my thesis committee members for their valuable suggestions and guidance throughout my research work. I would also like to acknowledge the support of **Prof. B. Sinha**, Head of the Department of Chemistry at NBU. I am thankful to all the Department of Chemistry faculty members for their support and encouragement and for serving as role models for my academic career.

I wish to acknowledge the invaluable contributions of my colleagues **Manas, Najmin, Sabbir, Pallabi, Tuhina, Madan,** and **Jyoti**, with whom working in the lab has been a joyous experience. I am also grateful to all my friends at NBU for their constant support and companionship, which have made my life more pleasant.

I thank the Science and Engineering Board (**SERB**), New Delhi, for the financial support and the Department of Science and Technology-Fund for Improvement of Science and Technology Infrastructure (**DST-FIST**) for providing research infrastructure.

Lastly, I am deeply indebted to several individuals who have motivated, encouraged, and supported me in all my pursuits. I extend my heartfelt gratitude to my parents, whose unwavering support and encouragement have been instrumental in all my achievements.

Mr. Ziaur Rahman
Research Scholar
Department of Chemistry
University of North Bengal
Darjeeling-734013, INDIA

Glossary of acronyms

EDA	Electron donor-acceptor
ET	Electron transfer
EDG	Electron donating group
EWG	Electron withdrawing group
HOMO	Highest occupied molecular orbital
LUMO	Lowest unoccupied molecular orbital
LMCT	Ligand to metal charge transfer
MLCT	Metal to ligand charge transfer
AIE	Aggregation-induced emission
ESIPT	Excited-state intramolecular proton transfer
PET	Photoinduced electron transfer
ICT	Intramolecular charge transfer
TICT	Twisted intramolecular charge transfer
FRET	Forster resonance energy transfer
ISC	Intersystem crossing
ACQ	Aggregation-caused quenching
AIEE	Aggregation-induced fluorescence enhancement
HPS	Hexaphenylsilole
RIR	Restriction of intramolecular rotation
NAC	Nitro-aromatic compound
SERS	Surface-enhanced resonance spectroscopy
MOF	Metal-organic framework
D	Donor
A	Acceptor
BSSS	Binding site signaling subunit
TMS	Tetramethylsilane
DMSO-d_6	Deuterated dimethyl sulfoxide
HRMS	High-resolution mass spectra
AcOH	Acetic acid
TFA	Trifluoroacetic acid
TEA	Triethylamine
LOD	Limit of detection

INH	INHIBIT
IMP	IMPLICATION
F^-	Fluoride
ACN	Acetonitrile
HSO_4^-	Hydrogen sulfate
TBA	Tetrabutylammonium
DFT	Density functional theory
TD-DFT	Time-dependent density functional theory
CPCM	Conductor-like polarizable continuum model
WHO	World Health Organization
AcO^-	Acetate
B-H	Benesi–Hildebrand
R^2	Regression coefficient
FMO	Frontier Molecular Orbital
Al^{3+}	Aluminium
FAO	Joint Expert Committee on Food Additive
PA	Picric acid
NAC	Nitro aromatic compound
SERS	Surface-enhanced Raman spectroscopy
IMS	Ion-mobility spectrometry
GC	Gas chromatography
FT-IR	Fourier transform infrared
TCSPC	Time-correlated single-photon counting
PPD	Photon Counting Detector
IRF	Instrument response function
HADF	Human Adult Dermal Fibroblast
S-V	Stern-Volmer
TNT	2, 4, 6-trinitrotoluene
DNT	2, 4-dinitrotoluene
4-NA	4-nitro aniline
2-NP	2-nitrophenol
4-NP	4-nitrophenol
DNP	2,4-dinitrophenol

TLC	Thin layer chromatography
IL	Ionic liquid
GUMBOS	Group of uniform materials based on organic salts
PbNa	Sodium of Pyrene butyric acid
$[TTP]^+Cl^-$	Trihexyltetradecylphosphonium chloride
NMR	Nuclear magnetic resonance
DSC	Differential scanning calorimetry
DLS	Dynamic light scattering
SEM	Scanning electron microscopic
THF	Tetrahydrofuran
CWA	Chemical warfare agent
GB	Sarin
GD	Soman
GA	Tabun
OP	Organophosphorus
IP	Inorganophosphorus
DCP	Diethylchlorophosphate
DCNP	Diethylcyanophosphonate
DMMP	Dimethylmethylphosphate
TIMEP	Tetra iso-propyl methylene diphosphonate
TMP	Tri methyl phosphate
NaH_2PO_4	Monosodium phosphate
Na_2HPO_4	Di sodium phosphate
Na_3PO_4	Tri sodium phosphate
HCl	Hydrochloric acid
TEP	Tri ethyl phosphate
$POCl_3$	Phosphoryl chloride
T_2CP	Tris(2-chloroethyl) phosphate
BA	Benzyl acetone
MCE	Mercaptoethanol
BB	Benzyl bromide
2CPS	2-chloroethyl phenyl sulfide
2CES	2-chloroethyl ethyl sulfide

TA	Thioacetic acid
OPD	O-phenylenediamine
HPLC	High-performance liquid chromatography
PCM	Polarizable continuum model
SCRF	Self-consistent reaction field
m_p	Melting point

List of figures

(C) AMA solution in contact with DCP vapor under the exposure of a 365 nm UV lamp.

List of tables

List of appendices