DEPARTMENT OF DYESTUFF TECHNOLOGY

ABOUT THE DEPARTMENT

PROFESSOR G. S. SHANKARLING
B. Sc. (Hon), B. Sc (Tech), M. Sc. (Tech), Ph.D. (Tech).
Professor of Dyestuff Technology
Head of the Department

The Department of Dyestuff Technology was established in 1944 under the stewardship of Prof. K. Venkataraman, the then director of Institute of Chemical Technology (ICT, then known as UDCT), University of Mumbai. Under the successive leadership of highly experienced, talented and hard-working scientists and scholars the department has trained more than 1200 undergraduate students and over 550 postgraduate students. The thrust area of this department is the development of organic chemical technologies, including dyestuff and intermediates, specialty and fine chemicals, agrochemicals, perfumery and flavor chemicals and process intensification in the above fields.

The department is a unique center of learning that offers an advanced curriculum in tune with the latest industrial and academic developments. The B. Tech course in Dyestuff Technology emphasizes the process chemistry, technology and engineering of organic intermediates and colorants. In the last few academic years, the department placed all graduating students in the chemical industry in various fields such as R & D, production, marketing, etc. A large number of students secured admissions along with financial aid in reputed universities across the globe. Thanks to generous financial support from Colourtex Pvt. Ltd, the department has initiated a major renovation of the undergraduate laboratory. A strong research focus in the area of functional colorants has enabled the department to file over 20 patents in the last two years and publish over 150 papers in international journals in the past five years. Recruitment of three young faculty members in the last two years under the auspices of the UGC Faculty Recharge Programme has finally ended a severe faculty crunch the department dealt with for more than a decade. The department tries to maintain close ties with the Indian dyestuff and chemical industry by way of organizing conferences, seminar and guest lectures. These activities not only bridge the gap between industries and academia it provides undergraduate students an excellent opportunity to interact with the industry.

The Department of Dyestuff Technology organizes conferences, seminar and guest lectures' every year in order to bridge the gap between industries and the academia. The objective of arranging such co –curricular activities enhances the exposure of the dyes and dyestuff manufacturing community to undergraduate and graduate students.

Dyes Department jointly organizes the International conference- "Convention on Colorants (COC)" biannually with DMAI (Dyestuff Manufacturers Association of India). The aim of the convention is to enhance cooperation between industry and academia. In the past eight years four such conferences were organized namely COC 2011, COC 2013, COC 2015, COC 2017.

In 2016, the department has started with a new concept of having an international symposium on ionic liquids to propagate a greener aspect of the chemistry to the world. On 21st and 22nd January 2016, the department had organized the International Symposium on Ionic Liquids (ISOIL

2016) in collaboration with Reliance Industries Ltd. The focus was given on industrial applications of ionic liquids. Apart from these technical events the department has been organizing "Dyes Day" since 2013, where all dyes alumni get chance to meet and have informal and formal discussions with each other. A panel discussion is organized where dyes alumni from industry share their experiences and help undergraduates to understand the current market status of dyes and chemical industries. The event ends with a cultural program where the students, faculty and alumni showcase their talent.

Along with this Department also organizes Memorial lecture series as a tribute to legends of department that includes K.V. Venkatraman lecture series, Kabbur Memorial lecture, Dr. KKG Menon lectures amongst others

VISION 2020

"To build world class programmes of excellence in education and research in specialized areas of Dyestuff, Chemistry and Technology for the benefit of society through problem solving competencies"

MISSION

The Department aspires to be one of the world's top ten colour chemistry departments by 2020. It will do so by:

Providing knowledge and skill based training at the undergraduate level by designing, teaching and periodically upgrading a colour chemistry and technology syllabus in line with current and anticipated trends in industry and academia.

Pursuing world-class research in the colourants and related areas – basic textile and leather coloration, functional colourants, organic process technology and specialty chemicals.

Proactively developing and maintaining close interaction with national and international research laboratories, universities and chemical industries

PROGRAMS OFFERED:

1. B.Tech (Dyes)
2. M.Tech (Dyes)
3. M.Tech (Perfumery and Flavour Technology)
4. M.Tech (Green Technology)
5. Ph.D (Tech)
6. Ph.D (Sci)

GIST OF PUBLICATIONS AND RELEVANT DETAILS

Faculty Profile												
Core Faculty	Industrial /PDF experience & Consultancy	Publications	Conference Proceedings	Patents	Book Chapters	Citations	i 10 Index	H-Index	Ph.D'S guided	Present Research Students		
		2013-18								Ph.D	M.Tech.	RA's
Prof. G. S. Shankarling Ph.D (Tech) - UDCT	8 Years of industrial experience and 29 consultancies	80	30	05	01	1423	44	19	11	15	07	-
Prof. P. M. Bhate Ph.D (Tech) – Ohio State Univ.	30 years industrial experience	10	12	02	-	78	03	06	03	01	-	-
Prof. N. Sekar Ph.D (Tech) - UDCT	24 Consultancies	178	10	08	04	1671	53	22	20	20	-	01
Dr. S. Some Ph.D (Sci)- IITKGP	6 years post doctoral experience	17	04	09	-	1102	23	18	-	06	-	02
Dr. S. Saha Ph.D (Sci) IITK	3 years post doctoral experience	05	01	-	-	424	09	09	-	01	-	01
Dr. N. Sadhukhan Ph.D (Sci) - IITK	6 year post doctoral experience	09	04	-	-	189	07	09	-	-	-	02

FUTURE PLANS

THE DEPARTMENT IS IN THE PROCESS OF UPGRADING ITS EXISTING INFRASTRUCTURE BY RENOVATING ITS' LABORATORIES

Building Plan Outlook

FRONT VIEW OF PROPOSED BUILDING

Present Status

FACULTY

PROFESSOR G. S. SHANKARLING
B. Sc. (Hon), B. Sc (Tech), M. Sc. (Tech), Ph.D. (Tech).
Professor of Dyestuff Technology
Head of the Department

SUBJECTS TAUGHT DURING 2017-18:

B. Tech

- DYT-1531 Chemistry and technology of speciality organic Intermediates and fine chemicals
- DYT-1601 Chemistry and technology of reactive, vat and cationic dyes
- DYT-1701 Chemistry of functional dyes
- DYT-1812 Introduction to green chemistry

M. Tech

- DYT-2001 Chemistry of functional colorants
- PFT-2001-Chemistry of perfumes and Flavours
- DYT-2802 Chemistry and technology of agro chemicals
- GTT 2104- Analysis and development of green Industrial process

RESEARCH INTERESTS:
Green Chemistry, Perfumary and Flavour Technology, Functional colorants, Supramolecular Chemistry, Metal-ion fluorescent sensor, Ultrasonics sonochemistry and Computational studies

PUBLICAITONS (PEER REVIEWED) SO FAR: 103

PATENTS: 19

CONFERENCE PROCEEDINGS/PAPERS: 71

SEMINARS/LECTURES/ ORATIONS DELIVERED: 32

PH.D.'S AWARDED AS SINGLE: 14

MASTERS AWARDED AS SINGLE: 29

H-INDEX: 19

CITATIONS: 1601

RESEARCH STUDENTS:
Ph.D. (Sci) in Chemistry-14
Ph.D. (Tech.) in Dyestuff Technology – 02
Ph.D. (Tech.) in Green Technology – 02
M. Tech in Green Technology-01
M. Tech in Perfumery - 02

RESEARCH PUBLICATIONS FOR CURRENT YEAR: - 24
Conference proceeding- 71
Book Chapter- 01

PATENTS:19

SPONSORED PROJECTS:
Completed - 10
Ongoing - 06

PROFESSIONAL ACTIVITIES (MEMBERSHIP OF IMPORTANT COMMITTEES):

i. Administrative Co-coordinator for Perfumery and Flavors Course.
ii. Placement coordinator of Perfumery and flavors
iii. Member of Editorial board for Bombay Technologist
iv. Member Technological Association
v. Life member UDCT Alumni Association
vi. Teqip Departmental coordinator
vii. Teqip in charge of student training programme
viii. Member, Board of governors,SVIMS
ix. Examiner for Ph.D. Thesis in Sardar Patel University, Gujarat.
x. Member of ICT Handbook committee.
xi. Member of ICT Annual Report.
xii. Member of ICT Diary student and faculty
xiii. Member of Exam Committee
xiv. Member of IIChE

SPECIAL AWARDS/ HONOURS / ACCOLADES TO STUDENTS:

(i) Mr.Mekonnen Habtemicheal was awarded first prize for the poster presentation in COC-2017.
(ii) Mr. Pravin Borase received third prize for the poster presentation in COC-2017.
(iii) Dr.Saurabh Deshpande

received best Thesis award of 2018.

HIGHLIGHTS OF RESEARCH WORK DONE AND IT'S IMPORTANCE:

(iv) Functional colorants: Thermochromic and Photochromic dyes, Metal sensors, Chemosensor for anions, Studies in Supramolecular Chemistry (macromolecules), Dye Sensitized solar cell (DSSC), Non-Linear Optics (NLO) etc.

(v) Dyes and pigments: High-performance pigment, Synthesis of colorant dyes.

(vi) Green chemistry: Catalytic system using enzyme for various Organic reaction, Preparation and application of ionic liquids for organic synthesis, Green chemistry and Technology mainly development of environmentally benign organic synthesis.

(vii) Process chemistry: Ultrasonic Sonochemistry, process intensification for development of azo dyes, Studies in oxidation reactions.

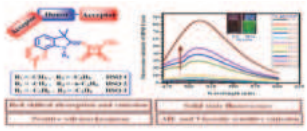


Fig A. Synthesis of NIR Fluorescent IndolenineBased semisquaraine Colorants

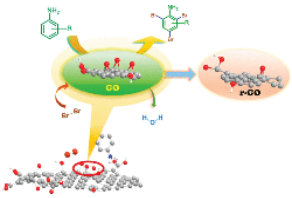


Fig.B. Graphene Oxide Promoted Oxidative Bromination of Anilines and Phenols in Water

In the recent years we have developed some greener protocols like synthesis of NIR fluorescent indolenine based symmetrical squaraine colorants. Also developed some environmentaly benign methodology for Graphene Oxide promoted oxidative bromintion of anilines and phenols in water, which are very helpful in dyestuff industry. Other research areas include use of Deep Eutectic Solvent as a green media for the various organic transformations. We are also working on synthesis of pigment using green media like DES as a solvent

PROFESSOR N. SEKAR

B.Sc. (Hon), B.Sc. (Tech), M.Sc. (Chemistry) Ph.D. (Tech), B. A (Music), M.A (German), M.Mus. (Indian Music)

Professor of Dyestuff Technology

RESEARCH INTERESTS:

Synthesis of multistep Heterocyclic and Fused Heterocyclic compounds, Process development of intermediates, Fluorescent compounds for bio- sensors, medical diagnostics and security strong disperse dyes sensing, Laser Dyes, NIR absorbing, fluorescing and reflecting colorants, Tinctorially, Extended Styryl dyes, Metal complex dyes for photovoltaics, Greener Methods for fluorescent compounds, Synthesis and formulation of perfumes and flavors, Computational Chemistry.

PUBLICATIONS (PEER REVIEWED) SO FAR: 452

PATENTS: 07 Filed

CONFERENCE PROCEEDINGS/PAPERS: 115

SEMINARS/LECTURES/ ORATIONS DELIVERED: 26

PH.D.'S AWARDED AS SINGLE: 5

MASTERS AWARDED AS SINGLE/ CO-GUIDE: 22

H-INDEX: 24

CITATIONS: 1893

RESEARCH STUDENTS:
PDF - 01
Ph.D. (Tech.) – 01
Ph.D. (Sci) -25

RESEARCH PUBLICATIONS:
International- 61
Peer-reviewed – 18
Conference proceeding- 21
Books- 02

PATENTS:
Indian – 07 filed

SPONSORED PROJECTS:
Government- 07

SPECIAL AWARDS/ HONOURS / ACCOLADES:

1. Awareded as an outstanding research faculty and top ten knowledge producers in India for the academic year 2017-2018

HIGHLIGHTS OF RESEARCH WORK DONE AND IT'S IMPART:

The present research activities include synthesis of multistep heterocyclic fluorescent compounds for biosensor, medicinal diagnostics and sensor for security applications. Process development of commercially important intermediates. The synthesis involves molecular design of fused heterocyclic compounds with the features of extended Styryl system giving NIR absorption and Fluorescence. We are also working on synthesis of nanomaterials for high-tech application and dyes for solar cell. Working on greener methods for heterocyclic systems, perfumes and flavors technology. Computational study for synthesized molecules.

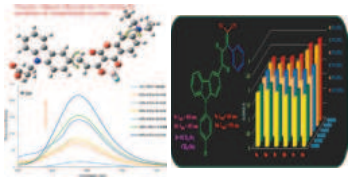


Fig A- viscosity enduce enhancement of emission of different molecules

PROFESSOR P. M. BHATE

B.Sc. (Hons), B.Sc. (Tech.), Ph.D.
Professor of Dyestuff Technology

RESEARCH INTERESTS:
Carbohydrate chemistry, Colour chemistry

PUBLICATIONS (PEER REVIEWED) SO FAR: 11

PATENTS: 02 Applied

CONFERENCE PROCEEDINGS/PAPERS: 09

SEMINARS/LECTURES/ ORATIONS DELIVERED: 14

PH.D.'S AWARDED AS SINGLE: 02

MASTERS AWARDED AS SINGLE/ CO-GUIDE: 03

H-INDEX: 4

CITATIONS: 124

RESEARCH STUDENTS:
Ph.D. (Sci) -04
Ph. D.(Tech.) - 01

RESEARCH PUBLICATIONS:
Peer-reviewed – 03

HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPART:

We have gathered conclusive evidence that cellulose-dye covalent bond is formed when an aryl diazonium salt prepared from a dyestuff having a primary aromatic amino group is allowed to react with cellulose under the usual dyeing conditions. Since a primary aromatic amino group is present in an overwhelming majority of commercial azo dyes, all such azo dyes, in principle, can now become reactive dyes by application of our methodology. We have shown that ninhydrin undergoes an unprecedented condensation reaction with various 2-aminobenzamide derivatives in boiling water to afford 11a-hydroxy-11, 11a-dihydrobenzo-[e] indeno[2,1-b][1,4]diazepine-10,12-dione derivatives. These hitherto unreported products are easily isolated in high yieldby a simple filtration step.

DR. SURAJIT SOME
Ph.D. (IIT KGP)
UGC-Assistant Professor of Dyestuff Technology

SUBJECTS TAUGHT DURING 2017-18:
Chemistry of Heterocycls, Use of Analytical Instruments in Synthetic Organic Chemistry, Chemistry and Technology of Benzene Intermediates-I, Mechanism of Organic Reactions, Analysis of Intermediates and Dyes and Fibers.

RESEARCH INTERESTS :
Graphene Nanotechnology, graphene quantum dot, Material Chemistry. Synthesis of graphene derivatives and their applications: Semiconductor materials, Energy storage materials, Flame retardant, waste water treatment, Bio-probes, Sensors, Anticancer materials, Surfactants, Advanced catalysts.

PUBLICATIONS (PEER REVIEWED) SO FAR: 31

PATENTS: 09

H-INDEX: 19

CITATIONS: 1230

RESEARCH STUDENTS:
Ph.D. (Sci) -06
RA - 02

RESEARCH PUBLICATIONS:
International- 05

PATENTS:
National – 05

SPONSORED PROJECTS:
Government- 04

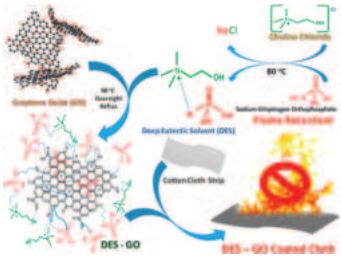
PROFESSIONAL ACTIVITIES (MEMBERSHIP OF IMPORTANT COMMITTEES):
American Chemical Society Member

SPECIAL AWARDS/ HONOURS / ACCOLADES:
CSIR Project sanctioned of 25.96 Lacs

HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPART:

a) Deep Eutectic Solvent Functionalized Graphene Composite as an Extremely High Potency Flame Retardant

ABSTRACT: We report a simple and green approach to develop the deep eutectic solvent functionalized graphene derivative as an effective flame retardant. The deep eutectic solvent functionalized graphene oxide (DESGO) was synthesized by introducing nitrogen-supported phosphorus functional groups on the surface of graphene derivative via a deep eutectic solvent, which is prepared by the treatment of monosodium dihydrogen orthophosphate and choline chloride. Subsequently, the resultant DESGO material is characterized by X-ray photoelectron spectroscopy, X-ray diffraction, Fourier transform infrared spectroscopy, Raman spectroscopy, thermogravimetric analysis, and scanning electron microscopy. The as prepared DESGO solution coated cloth piece was sustaining its initial shape and size by releasing a little amount of smoke at the early stage without catching fire for more than 540 s (9 min), whereas the pristine cloth is totally burned out within 10 s, leaving small amounts of black mass. This simple method of directly functionalized deep eutectic solvent on a graphene oxide surface can be a common process for the cost-effective bulk production of a nano carbon template for extremely high potency, nontoxic flame retardant applications.

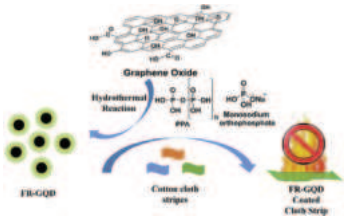


Scheme 1. Synthesis of Highly Efficient Flame Retardant (DESGO).

b) Novel approach towards the synthesis of carbon-based transparent highly potent flame retardant

ABSTRACT: In this article, a novel and facile method is proposed to synthesize a highly

effective carbon-based water dispersible flame retardant. This is the first report of carbon-based highly potent transparent flame retardant, which keeps the colour of the cloth intact. A functionalized flame retardant graphene quantum dots (FR-GQD) as a carbon-based material was synthesized using graphene oxide and phosphorous source through a hydrothermal treatment. As prepared transparent FR-GQD solution coated cotton cloth was found to maintain cloth's original colour. In a flame test, FR-GQD coated cloth emitted little smoke initially and after that, it failed to catch fire for more than 300 s and maintained its initial shape. Whereas the control cloth caught fire and burnt completely within 15 s. Flame retardant efficiency of the FR-GQD coated cloth was confirmed by detail flame tests such as limiting oxygen index (LOI), exposure to high heat flux (~50 kW/cm2) and turbulent premixed flame at high temperature (~1400 °C).The strength of FR-GQD coated cloth was determined using tensile strength test. This technique of synthesis and application of this water dispersed FR material may find a general approach towards the practical and eco-friendly application of non-toxic FR-GQD as transparent flame retardant.



Scheme 2. Synthesis of the graphene supported highly potent transparent flame retardant.

DR. SATYAJIT SAHA
Ph.D. (IITK)
UGC-Assistant Professor of Dyestuff Technology

SUBJECTS TAUGHT DURING 2017-18:

- Azo colorants
- Chemistry and Technology of Pigments
- Preparation and Analysis of Dyes, Intermediates, Optical Brighteners, Functional colorants
- Analysis of Inorganic Raw Materials used in Dyestuff Industry
- Introduction to Green Chemistry-Elective

RESEARCH INTERESTS: Asymmetric Organocatalysis, Mechanistic Organic Chemistry, Green Chemistry, DSSC, Functional Organic molecules

PUBLICATIONS (PEER REVIEWED) SO FAR: 15

PATENTS: Nil

CONFERENCE PROCEEDINGS/PAPERS: 03

SEMINARS/LECTURES/ ORATIONS DELIVERED: 02

PH.D.'S AWARDED AS SINGLE: Nil

MASTERS AWARDED AS SINGLE/ CO-GUIDE: Nil

H-INDEX: 9
CITATIONS: 514

RESEARCH STUDENTS:
Ph.D. (Sci) - 02
PDF - 01

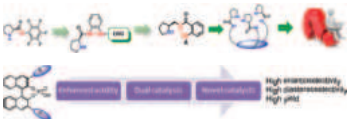
SPONSORED PROJECTS:
Government: 3
Private: Nil

HIGHLIGHTS OF RESEARCH WORK DONE AND ITS IMPART:

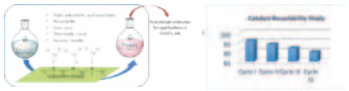
1. Highlights of research work done and it's impart:

The central theme of my research activities is synthetic organic chemistry, green chemistry, with a special focus on the design and development of novel catalysts and their application towards stereoselective synthesis both for the control of relative and absolute configuration as well as designing functional organic

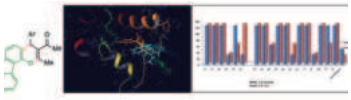
molecules for applications in DSSC, OLED's etc. The construction of complex molecular architectures, especially those with multiple stereogenic carbon atoms from simple chemicals, continues to be a resourceful effort in both academic and industrial domains. The challenge is intensified further when need to perform the reactions in an atom economical and non-hazardous way. Our research is aimed at designing novel catalysts (both organo- and metal based) with diverse chemical motifs which may have roles not only in catalytic activation but also in the orchestration or organization of the reacting components via supra molecular interactions. Structurally and functionally multifaceted organocatalysts may find new roles in organized catalysis for deeper access into chemical reaction space. Here the below scheme depicts the rational modification of catalysts structures and the hunt is on for a better catalyst.



Another aspect of our research is the application of solid supported catalysts in various organic transformations in a greener and cleaner way. The solid supported catalysts have received considerable importance in organic synthesis because of their ease of handling, enhanced reaction rates, greater selectivity, simple workup, low-cost, and recoverability and recyclability of catalysts. This catalyst can act as eco-friendly for a variety of organic transformations, non-volatile, recyclable, non-explosive, easy to handle, and thermally robust.



In pursuit of developing efficient organocatalytic strategies for the synthesis of novel heterocyclic compounds we have synthesized functionalized 4H-Chromens using cheap Brønsted acid catalyst under very ambient condition. The synthesized compounds were submitted to an in silico ADMET screening, to analyse their overall drug score and toxicity risks. Molecular docking studies were performed to understand the possible ligand-receptor intermolecular interactions as well as screened for their in vitro antibacterial activity.



Another facet of our research interest is design and synthesis of organic materials for Dye Sensitized Solar Cell (DSSC). Incessant growth of human population and improved living standards has resulted in a steep rise in world's energy consumption. Therefore, there is a rapid depletion of earth's fuel resources. This has directed the global scientific community to explore renewable energy resources, realizing solar energy as a much cheaper and efficient alternative. Organic Dye-sensitized solar cells (DSSCs) are identified as one such efficient converter of solar energy to electricity and are recognized as a novel substitution of the conventional silicon based solar cells due to its low-cost material, ease of fabrication and reasonably good power conversion efficiency. Although the scientific community has evidenced a quantum jump in the research related to organic DSSC in recent years, the cell efficiency and performance are still not at par with the metal complex based DSSC. It demands a more comprehensive understanding on the structure-property relation of the organic dyes wrt solar radiation absorption. Therefore, there is a relentless effort in fine-tuning the chemical structures of donors and acceptors of the dye molecules for improving efficiency and cell performance.

DR. NABANITA SADHUKHAN

B. Sc. (Chem. Hon), M. Sc. (Inorg. Chem), Ph.D. (IITK, Chemistry), Post-doc (Japan)

DST Young Scientist (2014),

CSIR-Pool Scientist (2014 – 2016) at CLRI

Assistant Professor of Dyestuff Technology (2016 – present)

SUBJECTS TAUGHT:

B. Tech

- DYT-1203 – Fluorescent colorant
- DYT-1102 – Technology of Intermediate II
- DYT-1102 – Technology of Intermediate II
- DYT-1203 – Chemistry of Functional colorant
- DYP-1002 – Chromatography Techniques

RESEARCH INTERESTS:

- Stimuli responsive biologically important functional molecules
- Functional colorants for biological application,
- Fluorescent dyes for cosmetic application,
- Monodisperse polymer,
- Stimuli responsive controlled release of fragrance from organic gel

PUBLICATIONS (PEER REVIEWED) SO FAR: 17

CONFERENCE PROCEEDINGS/PAPERS: 2

SEMINARS/LECTURES/ ORATIONS DELIVERED: 6

MASTERS AWARDED AS SINGLE: 2

H-INDEX: 08

CITATIONS: 230 (Google scholar)

NUMBER OF SPONSORED PROJECTS:

1) Government projects (ongoing)- 3 (CSIR = 1, DST-SERB = 1, TEQIPIII = 1)
2) Government projects (Completed) – 1 (UGC)

PROFESSIONAL ACTIVITIES (MEMBERSHIP OF IMPORTANT COMMITTEES):

Member of American Chemical Society

RESEARCH STUDENTS:

- Ph.D. (Sci) in Chemistry -1
- Project Assistant – 1
- Junior Research Fellow – 1

HIGHLIGHTS OF RESEARCH WORK DONE AND IT'S IMPORTANCE:

- **Stimuli responsive biologically important functional colorants for biological application:** We are working on bioinspired 'Molecular glue'. The synthesis, characterization and potential antitumor/ anticancer applications are our research interest.
- **Fluorescent dyes for cosmetic application:** Synthesis, characterization and application of fluorescent dyes for cosmetic application.
- **Monodisperse polymer:** Biological properties of monodisperse Polyethylene oxide (PEO) defers compared to polydisperse analogue. Now, we have started working on an eco-friendly process modification for the synthesis of polyethylene oxide towards monodispersisty and process intensification for upscale production following green technology protocol. Such processes will be highly useful for large scale production of high molecular weight monodisperse PEO by pharma-industry.
- **Stimuli responsive controlled release of fragrance from organic gel:** Synthesis and characterization of photo and thermo dual responsive organic gels that can entrap fragrance molecules. Controlled release of fragrances from the gel is under study.
- **Organometallic and inorganic coordination chemistry for functional**

application: Design of solvent dyes based ligands, which can occupy two or more metal centers together towards organometallic / bimetallic complexation, and their application in biologically relevant catalysis., LEDs involving multi-metal core.

SUPPORT STAFF

Mr. H. R. Fegade
(Instrument Mechanic)

Mr. S. B. Sonawane
(Senior Lab Assistant)

Mr. A. M. Patil
(Lab Assistant)

Mr. A. R. Rawool
(Lab Assistant)

Mr. S. B. Magdum
(Lab Assistant)

Mr. Y. S. Chandiwade
(Lab Attendant)

Mr. P. B. Rana
(Lab Attendant)

UNDERGRADUATE STUDENTS' SEMINARS/PROJECTS/HOME PAPERS:

Sr. No.	Name	Seminar Topic
1	Mr. Sairam Malekar	Natural Dyes for tumour detection
2	Mr. Pankaj Kumar	Cross conjugated chromophores
3	Ms. Minhaj Hannure	Vacuum systems in chemical plant
4	Mr. Manish Jain	Carbon supported material for dye degradation Color formers
5	Ms. Saily Bhagwat	Retinoids Dyes for smart fabric in defence applications
6	Ms. Abha Valavalkar	Packing for distillation column
7	Mr. Sudesh Tandlekar	Size reduction equipments used in chemical plant
8	Mr. Sourabh Patil	Croconium colorants Functional applications of azo colorants
9	Mr. Dhruv Sureka	Ionophores
10	Mr. Viraj Shinde	Conducting paints
11	Mr. Riddhesh Dani	Solar pigments
12	Ms. Aishwarya Gurav	Filtration media used in dye industries
13	Mr. Parth Parekh	Liquid level measuring equipments
14	Ms. Nupur Damke	Organometallic dyes for display applications
15	Ms. Nikita Gulgule	Green chemistry in Nitration

POST GRADUATE STUDENTS' SEMINARS

No.	Name of the Student (Beginning with Last name)	Topic
1	Chaudhari Sushil	Acid and base catalyzed reaction of Glycerol
2	Kamble Vidula	Life cycle assessment of solvent waste in perfumery industry
3	Bharose Manjusha	Silicones in enviornment

RESEARCH PROJECTS

PH.D. (TECH)

Sr. No.	Research Scholar (Beginning with Last name)	Previous Institution	Project	Supervisor
1.	More Priyanka	Institute of Chemical technology, Mumbai.	Utilization of biocatalyst in organic synthesis	Prof. G.S. Shankarling
2	Joglekar Amruta	Institute of Chemical technology, Mumbai	Development and characterization of specialty colorants using conventional and environmentally benign methods	Prof. G.S. Shankarling

3	Patil Yogesh	Institute of Technology,Nirma University, Ahmedabad	Dye degradation using metal organic framework	Prof. G.S.Shankarling
4	Chaturvedi Ankur	Institute of Chemical Technology	Characterization of Ionic Liquids	Prof. G. S. Shankarling
5	Mande Prashant	Institute of Chemical Technology	To be Decided	Prof. N. Sekar
6	Pratik Hande	Institute of Chemical Technology, Mumbai	Novel Reactive Dye System Based on Diazonium Salts	Guide- Prof. S. S. Bhagwat Co Guide- Prof. P. M. Bhate

PH.D. (SCIENCE)

Sr. No.	Research Scholar (Beginning with Last name)	Previous Institution	Project	Supervisor
1	Moolya Preetam	RPG Life Sciences	Synthesis of High performance colorants	Prof. G. S. Shankarling
2	Vajekar Shailesh	Ruparel College, Mumbai	Study and synthesis of novel colorant for High-tech application	Prof. G. S. Shankarling
3	Boraste Deepak	Acoris Research Ltd. Pune	Studies in synthesis and application of pyromethene derivative and cucurbitol host molecules	Prof. G.S. Shankarling
4	Ghorpade Prashant	VMV College, Amravati	Synthesis of novel deep eutectics and study of deep eutectics mixtures for catalytic action in organic synthesis	Prof. G.S. Shankarling
5	Gayakwad Eknath	Vidyabharti College Amaravati	Green methodologies for synthesis of novel heterocyclic colorants.	Prof. G.S. Shankarling
6	Kamble Sujit	Evotec India Ltd., India	Green approach in synthesis of heterocyclic compounds and synthesis of novel colorants.	Prof. G.S. Shankarling
7	Pant Preeti	V, G. Vaze College, Mumbai.	Synthesis of colourants for functional applications and implementation of green principles in organic reactions.	Prof. G.S. Shankarling

8	Rathi Jyoti	Vidyabharti College Amaravati	Implementation of Chiral Deep Eutectic solvent for selective organic synthesis.	Prof. G.S. Shankarling
9	Khopkar Sushil	University department Chemistry, Mumbai.	Synthesis, photophysical properties and application of novel squaraines	Prof. G.S. Shankarling
10	Jachak Mahesh	Centaur Pharmaceuticals Pvt. Ltd	Synthesis of novel colorants for metal sensor applications and ink jet ink formulations.	Prof. G.S. Shankarling
11.	Patel Khushbu	University department Chemistry, Mumbai.	Synthesis of grapheme oxide and its functionalized derivatives as an promising catalysts for organic transformations	Prof. G.S. Shankarling
12	Mehta Viral	Mithibai College, Mumbai	To be decided	Prof. G.S. Shankarling
13	Rupali Bhise	SRTMU Nanded	Deep Eutectic Solvent as a green media for oxidation reaction (TEQIP)	Prof. G. S. Shankarling
14	Jadhav Manoj	KET's V. G. Vaze College. Mulund, Mumbai.	Synthesis of Novel Colorants for Dyes Sensitized Solar Cells	Prof. N. Sekar
15	Ghorpade Seema	Shivaji University Kolhapur	Synthesis high performance fluorescent colorants and their biological applications	Prof. N. Sekar
16	Mallah Ramnath	Birala College Kalyan	Synthesis of Highly Fluorescent Fused Heterocyclic Compounds	Prof. N. Sekar
17	Erande Yogesh	S.S.G.M. College, Kopargon	Greener Methods for Synthesis of Heterocyclic Compounds	Prof. N. Sekar
18	Archana Bhagwat	New Arts, Science and Commerce College Ahmednagar	Synthesis and Photophysical Properties of Polycyclic Fluorescent Compounds	Prof. N. Sekar
19	Kiran Ahavad	Ahmednagar College, Ahmednagar	Synthesis and Applications of Heterocyclic Fluorescent ESIPT Fluorophore	Prof. N. Sekar
20	Dhanraj Mobiya	Department of Chemistry, Mumbai University	Synthesis of novel fluorescent dyes and their applications	Prof. N. Sekar

21	Manali Rajashirake	M .S. University, Badoda	Synthesis of High performance Fluoresecnt colourants for functional applications	Prof. N. Sekar
22	Mayuri Kadam	Department of Chemistry, Mumbai University	Synthesis of novel fused heterocyclic fluorescent compounds and their applications	Prof. N. Sekar
23	Prerana Lokhande	Department of Chemistry, ICT, Mumbai	Synthesis of novel fluorescent colorants	Prof. N. Sekar
24	Dinesh Patil	North Maharashtra University, Jalgaon.	Synthesis of Novel fluorescent fused heterocyclic colorant systems	Prof. N. Sekar
25	Sulochana Bhalekar	Ahmednagar college, Ahmednagar	Synthesis of fluorescent colourants	Prof. N. Sekar
26	Manish Raikwar	The D.G. Ruparel College	Synthesis of highly fluorescent heterocyclic compounds	Prof. N. Sekar
27	Suvidha Shinde	Department of Textiles and fibre processing and technology department, ICT, Mumbai	Application of fluorescent dyes on textile and leather substrate	Prof. N. Sekar&Prof. R.V. Adivarekar(Co-guide)
28	Mishra Virendra	University Of Mumbai. Kalina.	Synthesis of Fluorescent reactive dyes & their intermediates	Prof. N. Sekar
29	Nitesh N Ayare	ICT Mumbai.	Synthesis of fluorescent dyes with high performance.	Prof. N. Sekar
30	Yadav Sagar B.S.	University of Mumbai, Kalina.	Synthesis of Heterocyclic Dyes with High performance Fluorescence.	Prof.N.Sekar
31	Ramugade Supriya H.	ICT, Mumbai.	Synthesis and application of photostable dyes on textiles	Prof. N. Sekar & Prof. R.V. Adivarekar (Co-guide)
32	Ghanavatkar Chaitannya Waman	Gogate Jogalekar college Ratnagiri	Synthesis of photostable and Fluorescent reactive dyes & their intermediates	Prof.N.Sekar

33	Sharma Suryapratap	The Institute of Science , Mumbai	To be decided	Prof.N.Sekar
34	Zahir ali siddiqui	University of delhi	Design, synthesis and properties of dimeric acenes and their application for	Guide- Prof.N.Sekar Co-Guide Dr.Sandeep more
35	Zeba Khan	Jai hind college university of mumbai	Not yet decided	Prof. N.Sekar
36	Vandana kumari Shukla	University of pune	Not yet decided	Prof.N.Sekar
37	Sumeet Sonvane	Dr.Babasaheb Ambedkar Marathwada University, Aurangabad	Not yet decided	Prof.N.Sekar
38	Puja Omprakash Gupta	K.J. Somaiya college of science and commerce Mumbai University	Greener ways of production of High Performance Colorants – xanthenes and quinonoids (TEQIP)	Prof.N.Sekar
39	Nazim Ahmad Abdul Aleem	Shri Shivaji College of Arts, Commerce & Science College, Akola	Multicomponent approach for the synthesis of some heterocyclic systems	Prof. P. M. Bhate
40	Garande Ashok Malappa	Ahmednagar College, Ahmednagar	Attempts at structural elucidation of Cherimoline and synthesis of quinazoline and quinoxaline based heterocycles.	Prof. P. M. Bhate
41	Dugane Rajaram Gangaram	Department of Chemistry, Dr.Babasaheb Ambedkar Marathawada Univrsity, Aurngabad	Studies in Chiral synthesis	Prof. P. M. Bhate
42	Rajkumari Vijilata Devi	Ahmednagar College, Ahmednagar.	Development of a novel reactive dye system based on diazonium salts and synthesis of quinoxalines, quinazolines and benzodiazepines	Prof. P. M. Bhate

43	Dattatray Appasha Pethsangave	Dr. B.A.M.U. Aurangabad	UGC	Dr. Surajit Some
44	Rahul Vijay Khose	Wilson college Mumbai	BRNS-DAE	Dr. Surajit Some
45	Pravin Wadekar	Institute of science Mumbai	DST-SERB	Dr. Surajit Some
46	Pratik Dhumal	Dr. B.A.M.U. Aurangabad	ONGC	Dr. Surajit Some
47	Mahesh Bondarde	University of Pune	ONGC	Dr. Surajit Some
48	Madhuri Bhakare	Dr. B.A.M.U. Aurangabad	Green approach towards the synthesis of conductive paint from biomass. (TEQIP)	Dr. Surajit Some
49	Jejurkar Valmik Pandurang	University of Pune	Design and Synthesis of Novel Organic Dyes Based on Trogers's Base (TB) Architecture for Efficient Dye Sensitized Solar Cells (DSSC), DST-SERB	Dr. Satyajit Saha
50	Gauravi Yashwantrao	University of Mumbai	Process intensification by continuous-flow production of 2-aryl-1,2,3,4-tetrahydroquinoxaline derivatives in high optical purity mediated by immobilized organocatalyst (TEQIP)	Dr. Satyajit Saha
51	Tanvi Phoolchand Gupta	Jai Hind College, Mumbai	"An eco – friendly process modification for the synthesis of polyethylene oxide towards monodispersity and process intensification for upscale production following Green Technology protocol" (TEQIP)	Dr. Nabanita Sadhukhan

M. TECH.

Sr. No.	Research Scholar (Beginning with Last name)	Previous Institution	Project	Supervisor
1	Chaudhari Sushil M.Tech Perfumery	Government college of pharmacy, Amravati.	Synthesis of fragrance and flavor ingredients using DES and Ionic liquids	Prof. G.S. Shankarling
2	Kamble Vidula M.Tech Perfumery	Sharad pawar collage of food technology	Synthesis of Jasmine odorants through green routes	Prof. G.S. Shankarling

3	Bharose Manjusha M.Tech Green tech	Department of chemical technology, Dr. BAMU Aurangabd	Synthesis of basic Ionic liquid: A useful reaction solvent and/or catalysis	Prof. G.S. Shankarling

POSTDOCTORAL STUDENTS

No.	Research Scholar(Beginning with Last name)	Previous Institution	Project	Supervisor
1	Dr. Dipti Lakhe	IIT BOMBAY	Synthesis of novel fluorescent cyanine dyes for High technology application	Prof.N.Sekar
2	Dr.Kshatriya Rajpratap	University of Pune	A Novel Approach Of Rational Catalyst Design For The Direct Enantioselective α-Allylation/Alkylation Of Ketones	Dr. Satyajit Saha

DETAILS OF SPONSORED PROJECTS

GOVERNMENT AGENCIES:

Sponsor	Title	Duration	Total amount (Rs.)	Principal Investigator	Research Fellows
AICTE-RPS	Synthesis of novel perimidine and quinaldine based NIR absorbing squaraines dyes and study of their thermal and photophysical properties	Three Years	750000/-	Prof. G.S. Shankarling	Sushil Khopkar
DAE-BRNS	Development and characterization of selective coating for enhancement of radiation absorption of solar receivers.	Two Years	1, 43, 35,000/-	Prof. G.S. Shankarling/ Dr. V. D. Deshpande	Amruta Joglekar
DAE-BRNS	Synthesis and Purification of Spectroscopic grade Cucurbituril[7] for high power aqueous dye laser applications	Three Years	30,44,800 /-	Prof. G.S. Shankarling	Deepak Boraste

Principal Scientific Advisor to GOI PSA –II (DST)	Development & Optimization Studies with an alternate route for vinylsulphones and Novel vinylsulphones	3 year	Rs.59,13,000	Prof. N. Sekar	Mr.Virendra R. Mishra Mr. Chaitanya W. Ghanvatkar
WRA	Synthesis of water soluble fluorescent colourents for high visible hydrophilic textile substrates	3 years	59,40,856	Prof. N. Sekar Smita Honade Bait	Zeba Khan
DST -CERI	Coloured fluorescent conducting oligomers / monomers for dye sensitized solar cell	3 Year	88,78,099	Prof. N. Sekar	Ms.Vandana Shukla
DST-SERB	Phenonthroline-ly Coupled Tetracene Dimers (PCTD)-Novel Materials for Organic Electronics	3 Year	37,58,480	Guide-Prof. N. Sekar Co-Guide Sandeep more	Zahir Siddhique
DAE-ICT	high-performance laser dyes design and synthesis	3 years	34,82,500	Prof.N.Sekar	Sumeet Sonvane
TEQlP -III	Geener way of production of High performance colorants-Xanthenes and Quinonoids	2 Year	5,20,000	Prof.N.Sekar	Puja Omprakash Gupta
DST	Designing and synthesis of novel fluorescent cyanine dyes for Hi-technology application	3 Year	30, 00,000	Prof. N. Sekar	Ms. Dipti Lakhe Chawade (Post-Doctorate Research Fellow)
Ministry of Textiles	Novel Reactive Dye System Based on Diazonium Salts	3 years	Rs 27.84 lacs	Prof Prakash Bhate	Pratik Hande
UGC	Graphene supported chiral reagent	3years	6 Lacs	Dr. Surajit Some	Dattatray Appasha Pethsangave
BRNS	Tunable laser properties of dye decorated graphene derivatives	3 years	27.78 Lacs	Dr. Surajit Some	Rahul khose

DST-SERB	Synthesis of 3D, fixable heteroatom doped carbon based metal oxide containing nanocomposites for its high-performance supercapacitor application	3 years	25.81 Lacs	Dr. Surajit Some	Rini Jain
CSIR	Synthesis of Graphene Based Bioadsorbent for west stream treatment	3 years	29.26 Lacs	Dr. Surajit Some	Dnyaneshwar K.Kulal (Reasearch Associative)
ONGC	Development of Graphene based supercapacitor employing improved protocols for preparation of graphene	15 Month	14,70,000	Dr. Surajit Some	Pravin H.Wadekar
ONGC	Development spongy Graphene Materials for Recovery of crude oil from Effluent water	15 Month	14,59000	Dr. Surajit Some	1.Pratik Dhumal 2.Mahesh Bondarde
SERB-DST	Design and Synthesis of Novel Organic Dyes Based on Trogers's Base (TB) Architecture for Efficient Dye Sensitized Solar Cells (DSSC)	3 years (2015-2018)	Rs. 29,99,000	Dr. Satyajit Saha	Valmik Jejurkar Pandurang
CSIR	A Novel Approach Of Rational Catalyst Design For The Direct Enantioselective α-Allylation/Alkylation Of Ketones	3 years (2016-2019)	Rs. 25 46,000	Dr. Satyajit Saha	Dr. Rajpratap Kshatriya
UGC	Co-operative Organocatalysts for Enantioselective Transformations	2 years (2015-2017)	Rs. 6,00,000	Dr. Satyajit Saha	-
CSIR	Novel approach to make tailored design molecular glue from bioinspired dye molecule: evaluation of properties and potential anticancer applications	3 years (2018-2021)	Rs. 12,98,667	Dr. Nabanita Sadhukhan	Criss Dcosta

UGC	Synthesis and application of novel water soluble organic and inorganic small molecules for bio-mimicking applications	2 years, 2016 - 2018	6 lac	Dr. Nabanita Sadhukhan	-
DST – SERB	Synthesis and characterization of amphiphilic PEG foldamer for mimicking stimuli-responsive ion pump	3 years, 2015 - 2018	20.3 lac	Dr. Nabanita Sadhukhan	Chinmay Thakkar

PRIVATE AGENCIES /INDUSTRIES:

Sponsor	Title	Duration	Total amount	Principal Investigator	Research Fellows
Transition Optical Corporation,USA	Synthesis of Azo and anthraquinone dyes.	One year	20,00,000 /-	Prof.G.S. Shankarling	Rishikant Sonune
Essilor International Ltd.	Development of IPP resistant Blue dye and UV-absorber	One year	26,00000/-	Prof.G.S. Shankarling	Dr. Haribhau Kumbhar
Deepak Nitrite Ltd	Synthesis of optical brightening agents	One year	9,50,000 /-	Prof.G.S. Shankarling	Mr. Anand Parashar

DETAILS OF NATIONAL AND INTERNATIONAL COLLABORATIONS:

Prof. G.S. Shankarling

- Dr. Douglas McFarlane and Dr. Vijay Raghvan, Monatsche University, Australia.
- Dr. Suban Sahoo, SVNIT, Gujarat.
- Dr. Hirendra Gosh, BARC, Mumbai.
- Dr. Alok Ray, BARC, Mumbai.
- Dr. Shakti Vinay Shukla, Principle Director, Fragrance and Flavor Development Center (FFDC), Kannuaj, U.P

PUBLICATIONS (PEER REVIEWED):

No.	Title and authors	Journal	Vol. No.	Pages	Year
1	Greener Protocol for the Synthesis of NIR Fluorescent Indolenine-Based Symmetrical Squaraine Colorants Khopkar, S., Deshpande, S., Shankarling, G.	ACS Sustainable Chemistry and Engineering	6(8)	10798-10805	2018
2	Graphene Oxide Promoted Oxidative Bromination of Anilines and Phenols in Water Ghorpade, P.V., Pethsangave, D.A., Some, S., Shankarling, G.S.	Journal of Organic Chemistry	83(14)	7388-7397	2018
3	Application of Fe3 O4 @Silica Sulfuric Acid as a Magnetic Nanocatalyst for the Synthesis of Rhodamine Derivatives Vajekar, S.N., Shankarling, G.S.	Chemistry Select	3(21)	5848-5852	2018
4	Ru(Cl)-Salen Complex: Solvent Selective Homogeneous Catalyst for One-Pot Synthesis of Nitriles and Amides Borase, P.N., Thale, P.B., Shankarling, G.S.	Chemistry Select	3(20)	5660-5666	2018
5	Choline Hydroxide Promoted Synthesis of N-Aryl Anthraquinone Derivatives: Metal Free Approach to Ullmann Coupling Reactions Pant, P.L., Sonune, R.K., Shankarling, G.S.	Chemistry Select	3(19)	5249-5253	2018
6	Supramolecular host-guest interaction of antibiotic drug ciprofloxacin with cucurbit[7]uril macrocycle: Modulations in photophysical properties and enhanced photostability Boraste, D.R., Chakraborty, G., Ray, A.K., Shankarling, G.S., Pal, H.	Journal of Photochemistry and Photobiology A: Chemistry	358	26-37	2018

7	A simple substituted spiropyran acting as a photo reversible switch for the detection of lead (Pb2+) ions Deshpande, S.S., Jachak, M.A., Khopkar, S.S., Shankarling, G.S.	Sensors and Actuators, B: Chemical	258	648-656	2018
8	A Unique Blend of Water, DES and Ultrasound for One-Pot Knorr Pyrazole Synthesis and Knoevenagel-Michael Addition Reaction Kamble, S.S., Shankarling, G.S.	Chemistry Select	3(7)	2032-2036	2018
9	Recent advances in synthetic methodologies for transition metal-free Ullmann condensation reactions Pant, P.L., Shankarling, G.S.	New Journal of Chemistry	42(16)	13212-13224	2018
10	A thiazoloquinoxaline based "turn-on" chemodosimeter for detection of copper ions Deshpande, S.S., Khopkar, S.S., Shankarling, G.S	Dyes and Pigments	147	393-399	2017
11	Metal-free oxidation of aldehydes to acids using the 4Na2SO4•2H2O2•NaCl adduct Gayakwad, E.M., Patil, V.V., Shankarling, G.S.	Environmental Chemistry Letters	15(3)	459-465	2017
12	Process intensification in azo dyes Shankarling, G.S., Deshmukh, P.P., Joglekar, A.R	Journal of Environmental Chemical Engineering	5(4)	3302-3308	2017
13	Deep Eutectic Solvent/Lipase: Two Environmentally Benign and Recyclable Media for Efficient Synthesis of N-Aryl Amines Pant, P.L., Shankarling, G.S.	Catalysis Letters	147(6)	1371-1378	2017
14	Reversible 'turn off' fluorescence response of Cu2+ions towards 2-pyridyl quinoline based chemosensor with visible colour change More, P.A., Shankarling, G.S.	Sensors and Actuators, B: Chemical	241	552-559	2017

15	Solvatochromic fluorescence properties of phenothiazine-based dyes involving thiazolo[4,5-b]quinoxaline and benzo[e] indole as strong acceptors Deshpande, S.S., Kumbhar, H.S., Shankarling, G.S.	Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy	174	154-163	2017
16	Choline based ionic liquids and their applications in organic transformation Gadilohar, B.L., Shankarling, G.S.	Journal of Molecular Liquids	227	234-261	2017
17	An Effect of H-bonding in Synthesis of 1, 5-Diketones via Tandem Aldol-Michael Addition Reaction Using Room Temperature Ionic Liquid (RTIL). Kamble, S.S., Shankarling, G.S.	Chemistry Select	2(5)	1917-1924	2017
18	Energy efficient Pfitzinger reaction: A novel strategy using a surfactant catalyst More, P.A., Shankarling, G.S	New Journal of Chemistry	41(21)	12380-12383	2017
19	Deep Eutectic Solvent: An Efficient and Recyclable Catalyst for Synthesis of Thioethers. Pant, P.L., Shankarling, G.S.	Chemistry Select	2(25)	7645-7650	2017
20	Deep Eutectic Solvent: An Efficient Catalyst for C-O Coupling Reactions. Pant, P.L., Shankarling, G.S.	Chemistry Select	2(17)	4892-4898	2017
21	Efficient, facile metal free protocols for the bromination of commercially important deactivated aminoanthracene-9,10-diones Patil, V.V., Gayakwad, E.M., Patel, K.P., Shankarling, G.S.	Tetrahedron Letters	58(26)	2608-2613	2017
22	[Amberlyst-15 - (4Na2SO4-2H2O2-NaCl) Adduct]: Direct Access to Synthesize Acylureas via Oxidative Amidation of Aldehyde Gayakwad, E.M., Patil, V.V., Patel, K.P., Shankarling, G.S.	Chemistry Select	2(29)	9511-9515	2017

23	Amberlyst-15 catalysed oxidative esterification of aldehydes using a H2O2trapped oxidant as a terminal oxidant Gayakwad, E.M., Patil, V.V., Shankarling, G.S.	New Journal of Chemistry	41(7)	2695-2701	2017
24	pH-Responsive Interaction of Fluorogenic Antimalarial Drug Quinine with Macrocyclic Host Cucurbit[7]uril: Modulations in Photophysical and Acid-Base Properties Boraste, D.R., Chakraborty, G., Ray, A.K., Shankarling, G.S., Pal, H.	Chemistry Select	2(18)	5128-5142	2017
25	Effect of methoxy group on NLOphoric properties of fluorescent 7-arylstyryl-2-methoxyphenylimidazo [1,2-a]pyridine - Solvatochromic and computational method Jadhav, S.D., Alswaidan, I.A., Rhyman, L., Ramasami, P., Sekar, N	Journal of Molecular Structure	1173	349-365	2018
26	4-(Diethylamino) salicylaldehyde based fluorescent Salen ligand with red-shifted emission – A facile synthesis and DFT investigation Kadam, M.M.L., Patil, D., Sekar, N.	Journal of Luminescence	204	354-367	2018
27	Highly fluorescent blue-green emitting phenanthroimidazole derivatives: Detail experimental and DFT study of structural and donating group effects on fluorescence properties Kothavale, S., Bhalekar, S., Sekar, N.	Dyes and Pigments	159	209-221	2018
28	NIR emitting new N, N-diethylaniline based NLOphoric D-π-A and D-A'-π-A dyes: Photophysical properties, viscosity sensitivity and DFT studies Patil, D., Jadhav, M., Avhad, K., Gawale, Y., Sekar, N.	Journal of Luminescence	204	436-447	2018

29	Fluorescent carbazole based pyridone dyes – Synthesis, solvatochromism, linear and nonlinear optical properties Kadam, M.L., Patil, D., Sekar, N.	Optical materials	85	308-318	2018
30	Viscosity-active D-π-A chromophores derived from benzo[b]thiophen-3(2H)-one 1,1-dioxide (BTD): Synthesis, photophysical, and NLO properties Bhagwat, A.A., Mohbiya, D.R., Avhad, K.C., Sekar, N.	Spectrochimica Acta - Part A: Molecular and Biomolecular Spectroscopy	203	244-257	2018
31	Carbazole based NLOphoric styryl dyes-synthesis and study of photophysical properties by solvatochromism and viscosity sensitivity Kadam, M.M.L., Patil, D., Sekar, N.	Journal of Luminescence	2	2012-2014	2018
32	Excitation energy transfer processes in BODIPY based donor-acceptor system - Synthesis, photophysics, NLO and DFT study Mallah, R., Sreenath, M.C., Chitrambalam, S., Joe, I.H., Sekar, N.	Optical Materials	84	795-806	2018
33	Fluorescent meso-benzyl curcuminoid boron complex: Synthesis, photophysics, DFT and NLO study Mallah, R.R., Mohbiya, D.R., Sreenath, M.C., (...), Joe, I.H., Sekar, N.	Optical materials	84	786-794	2018
34	Electronic structure and spectral properties of indole based fluorescent styryl dyes: Comprehensive study on linear and non-linear optical properties by DFT/TDDFT method Mohbiya, D.R., Sekar, N.	Computational and Theoretical Chemistry	1139	90-101	2018
35	Influence of electron donors in fluorescent NLOphoric D-π-A derivatives with acenaphthene rotor: Photophysical, viscosity, and TD-DFT studies Mohbiya, D.R., Mallah, R.R., Sekar, N.	Journal of Photochemistry and Photobiology A: Chemistry	364	40-52	2018

36	Low cost and efficient hetero-anthracene based small organic hole transporting materials for solid state photoelectrochemical cells Vaghasiya, J.V., Sonigara, K.K., Patel, M.H., (...), Sekar, N., Soni, S.S.	Materials Today Energy	9	496-505	2018
37	Viscosity sensitive fluorescent coumarin-carbazole chalcones and their BF2 complexes containing carboxylic acid – Synthesis and solvatochromism Rajeshirke, M., Tathe, A.B., Sekar,N	Journal of Molecular Liquids	264	358-366	2018
38	Linear correlation between DSSC efficiency, intramolecular charge transfer characteristics, and NLO properties – DFT approach Patil, D.S., Avhad, K.C., Sekar, N.	Computational and Theoretical Chemistry	1138	75-83	2018
39	Highly Stoke shifted near infrared (NIR) emitting donor-pi-acceptor chromophore: Synthesis and combined experimental and computational studies of photophysical properties Jadhav, M.M., Patil, D., Sekar, N.	Journal of Photochemistry and Photobiology A: Chemistry	363	13-22	2018
40	Azo Acid Dyes Based on 2H-Pyrido[1,2-a]Pyrimidine-2,4(3H)-Dione with Good Tinctorial Power and Wetfastness - Synthesis, Photophysical Properties, and Dyeing Studies Gawale, Y., Jadhav, A., Sekar, N	Fibers and Polymers	19(8)	1678-1686	2018
41	Enhancement of NLO Properties in OBO Fluorophores Derived from Carbazole-Coumarin Chalcones Containing Carboxylic Acid at the N-Alykl Terminal End Rajeshirke, M., Sreenath, M.C., Chitrambalam, S., Joe, I.H., Sekar, N.	Journal of Physical Chemistry C	122(26)	14313-14325	2018

42	Spectroscopic and DFT approach for structure property relationship of red emitting rhodamine analogues: A study of linear and nonlinear optical properties Jadhav, A.G., Rhyman, L., Alswaidan, I.A., Ramasami, P., Sekar, N.	Computational and Theoretical Chemistry	1131	1-12	2018
43	Viscosity induced emission of red-emitting NLOphoric coumarin morpholine-thiazole hybrid styryl dyes as FMRs: Consolidated experimental and theoretical approach Avhad, K.C., Patil, D.S., Chitrambalam, S., (...), Joe, I.H., Sekar, N.	Optical Materials	79	90-107	2018
44	Large Stokes Shifted Far-Red to NIR-Emitting D-π-A Coumarins: Combined Synthesis, Experimental, and Computational Investigation of Spectroscopic and Non-Linear Optical Properties Avhad, K.C., Patil, D.S., Gawale, Y.K., (...), Joe, I.H., Sekar, N.	Chemistry Select	3(16)	4393-4405	2018
45	Red Emitting Monoazo Disperse Dyes with Phenyl(1H-benzoimidazol-5-yl) Methanone as Inbuilt Photostabilizing Unit: Synthesis, Spectroscopic, Dyeing and DFT Studies Jadhav, A.G., Shinde, S.S., Sekar, N.	Journal of Fluorescence	28(2)	639-653	2018
46	Bedford-type palladacycle-catalyzed miyaura borylation of aryl halides with tetrahydroxydiboron in water Zernickel, A., Du, W., Ghorpade, S.A., (...), Sekar, N., Eppinger, J.	Journal of organic chemistry	83(4)	1842-1851	2018

47	Tuning 'Stokes Shift' and ICT Character by Varying the Donor Group in Imidazo[1,5 a]pyridines: A Combined Optical, DFT, TD-DFT and NLO Approach Mohbiya, D.R., Sekar, N.	Chemistry select	3(6)	1635-1644	2018
48	Fluorescent pyridopyrimidine fused pyranones - design, synthesis, fluorescent whitening and DFT studies Gawale, Y., Sekar, N.	Journal of Luminescence	194	248-256	2018
49	NLO properties of ester containing fluorescent carbazole based styryl dyes – Consolidated spectroscopic and DFT approach Rajeshirke, M., Sekar, N.	Optical material	76	191-209	2018
50	Auxiliary Methoxy Aided Triphenylamine and Dicyanoisophorone Based Flurophores with Viscosity and Polarity Sensitive Intramolecular Charge Transfer	Journal of Solution Chemistry	47(2)	353-372	2018
51	Phenylpyran-fused coumarin novel derivatives: combined photophysical and theoretical study on structural modification for PET-inhibited ICT emission Jadhav, A.G., Shinde, S.S., Patil, D.S., Sekar, N.	Structural Chemistry	29(1)	217-230	2018
52	Triphenylamine Derived 3-Acetyl and 3-Benzothiazolyl Bis and Tris Coumarins: Synthesis, Photophysical and DFT Assisted Hyperpolarizability Study Erande, Y., Kothavale, S., Sreenath, M.C., (...), Joe, I.H., Sekar, N.	Journal of Electronic Materials	47(2)	1431-1446	2018

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68	Synthesis of Novel Thiazole Based Carbaldehyde as Potential Sensor for Fluoride Anion and their Spectroscopic Properties Tayade, R.P., Sekar, N.	Journal of Fluorescence	27(3)	1117-1128	2017
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75	NLOphoric mono-azo dyes with negative solvatochromism and in-built ESIPT unit from ethyl 1,3-dihydroxy-2-naphthoate: Estimation of excited state dipole moment and pH study Warde, U., Sekar, N.	Dyes and Pigments	137	384-394	2017
76	Deep red emitting triphenylamine based coumarin-rhodamine hybrids with large Stokes shift and viscosity sensing: Synthesis, photophysical properties and DFT studies of their spirocyclic and open forms Kothavale, S., Jadhav, A.G., Sekar, N.	Dyes and Pigments	137	329-341	2017
77	Non-linear optical study of BODIPY-benzimidazole conjugate by solvatochromic, Z-scan and theoretical methods Thakare, S.S., Sreenath, M.C., Chitrambalam, S., Joe, I.H., Sekar, N.	Optical Materials	64	460-453	2017

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80	Coumarin-Rhodamine Hybrids – Synthesis, Photophysical Properties, NLO Properties and DFT Studies Shreykar, M.R., Sekar, N.	Chemistry Select	2(4)	1464-1478	2017
81	A New Series of Highly Fluorescent Blue-Green Emitting, Imidazole-Based ICT-ESIPT Compounds: Detail Experimental and DFT Study of Structural and Donating Group Effects on Fluorescence Properties Kothavale, S., Sekar, N	Chemistry Select	2(25)	7691-7700	2017
82	Novel Thiazole Based Styryl Dyes with Benzimidazole Unit - Synthesis, Photophysical and TD-DFT Studies Tayade, R.P., Sekar, N.	Journal of Fluorescence	27(1)	167-180	2017
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84	Modulating TICT to ICT characteristics of acid switchable red emitting boradiazaindacene chromophores: Perspectives from synthesis, photophysical, hyperpolarizability and TD-DFT studies	Dyes and Pigments	136	321-334	2017

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87	Graphene Oxide Promoted Oxidative Bromination of Anilines and Phenols in Water Prashant Vasantrao Ghorpade, Dattatray Appasha Pethsangave, Surajit Some, and Ganapati Subray Shankarling	J. Org. Chem.	83	7388–7397	2018
88	A Ultrasound Promoted Enantio-selective Decarboxylative Protonation of α- Aminomalonate Hemiesters by Chiral Squaramides: A Practical Approach to Both Enantiomers of α-Amino Esters Surajit Some, Han Yong Bae, Mun Jong Kim, Yong Jian Zhang and Choong Eui Song	Eur.J.Org.Chem		4562–4565	2017
89	Deep Eutectic Solvent Functionalized Graphene Composite as an Extremely High Potency Flame Retardant. Surajit Some, Dattatray A. Pethsangave, Rahul V. Khose, Pravin H. Wadekar.	ACS Appl. Mater. Interfaces	9	35319–35324	2017
90	Novel approach towards the synthesis of carbon-based transparent highly potent flame retardant	Carbon	139	205-209	2018
91	Scope and Advances in Catalytic Propargylic Substitution Reactions Rashmi Roy and Satyajit Saha	RSC Advances	8	31129-31193	2018

92	Recent advances in the catalytic synthetic approaches of triaryl methanes Rajpratap Kshatriya, Valmik P. Jejurkar and Satyajit Saha				2018
93	Brønsted Acid Catalyzed Domino Michael Addition and Cyclocondensation Towards the Synthesis Of Functionalized 4H-Chromens And Their ADMET, Molecular Docking And Antibacterial Studies. R. Kshatriya, S. Mali, H, Choudhury and Satyajit Saha				2018
94	In memory of Prof. Venkataraman: recent advances in the synthetic methodologies of flavones Rajpratap Kshatriya, Valmik Jejurkar and Satyajit Saha	Tetrahedron	74	811-833	2018
95	Environmentally benign, highly efficient and expeditious solvent-free synthesis of trisubstituted methanes catalyzed by sulfated polyborate Valmik Jejurkar, Chetan K. Khatri, Ganesh U. Chaturbhuj and Satyajit Saha	Chemistry Select	2	11693-11696	2017

PATENTS:

No.	Inventors	Title	Country	Funding agency
1	Shankarling G.S.; Boraste Deepak	Process for preparing Cucurbituril in high yield	India	BARC
2	Shankarling G.S.; Joglekar Amruta	Synthesis of copper phthalocyanine using Deep Eutectic Solvent.	India	-
3	Surajit Some and Dattatray A. Pethsangave	Graphene Supported Green Approach for Highly Efficient Fire Retardant	India	TEQIP (INN)
4	Surajit Some and Dattatray A. Pethsangave, Pushpito Ghosh	Magnetic Graphene-Carrageenan-Iron Oxide Composite for absorption of Oils with recycle and reuse	India	TEQIP (INN)

5	Surajit Some and Dattatray A. Pethsangave	Development of method to synthesize novel polymer based composite as an efficient flame retardant thereof	India	TEQIP- ICT
6	Surajit Some, Pravin H. Wadekar	Development of method to synthesize Aqueous Dispersible Reduced Graphene oxide.	India	TEQIP- ICT
7	Surajit Some, Rahul V. Khose and Alok Ray	Flame retardant transparent liquid based on novel functionalized Graphene Quantum Dot Provisional Patent Filled	India	BARC

BOOK CHAPTER:

No.	Author(s)	Title of the chapter	Editor	Publisher	Place	Year	Page
1.	Prof. G. S. Shankarling	Culture of Indigo in Asia	Kapila Vatsyayan	Niyogi Books	New Delhi	2014	122-134

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- Tequip in charge of student training programme
- Administrative Co-coordinator for Perfumery and Flavors Course.
- Placement Officer of Perfumery & Flavor Technology
- Member of Merit-cum-means and Trust scholarship, ICT
- Co-Chairperson of Publication committee (Annual Report, Student diary, ICT diary, and Posters

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- Co-ordinator for the Centre for Physico-Chemical Aspects in Textiles, Fibres, Dyes and Polymers (UGC-SAP).
- Deputy Coordinator , COSIST Programme
- Departmental Representative, CAS Programme
- Coordinator, In-plant Training for T.Y. B. Tech students
- Coordinator, TEQIP Seminar (Services to Society)
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PASSED OUT STUDENTS

PH.D. STUDENTS

Name	Course	Title
Pravin Borse	Ph.D.	Synthesis of Novel Fluorescent Organoboron, Styryl and Spiropyran Colorants And Their Applications As Chemosensor
Saurabh Deshpande	Ph.D.	Synthesis and Application of Novel Biodegradable Multi Task Specific Ionic Liquids in Organic Synthesis
Amol jadhav	Ph.D. (Sc.)	Synthesis of High Performance Fluorescent Fused Heterocyclic Systems
Ankush More	Ph.D. (Sc.)	Design and synthesis of efficient fluorescent dyes with enhanced photophysical properties
Santosh Kataria	Ph.D. (Sc.)	Synthesis of fused heterocycles with high hyperpolarisability
Shantaram Kothavale	Ph.D. (Sc.)	Synthesis of Fluorescent Colorants for their Biological Applications
Shrikant thakare	Ph.D. (Sc.)	Synthesis of High Performance Fluorescent Colorants with Enhanced Photo physical properties
Yogesh Gavale	Ph.D. (Sc.)	Synthesis and photophysical properties of functional molecules
Umesh Warde	Ph.D. (Sc.)	Synthesis of Novel High Performances Functional Colorants
Siddheshwar Jadhav	Ph.D. (Sc.)	Synthesis of fused heterocyclic fluorophores with non linear optical properties
Sharad Patil	Ph.D. (Sc.)	Greener Routes for Heterocyclic Intermediate in synthesis of Fluorescent Colorants.
Vadagaonkar Kamlesh Shashikant	Ph. D (Sc.)	Development of Synthetic Methodologies Leading to Functional Colorants, Heterocycles, Ketoesters and Amides

M. TECH. STUDENTS

Name	Course	Title
Pritesh Patil	M.Tech	Green synthetic method for synthesis of anthraquinone derivatives and hydroxymethylation of phenol derivative
Mekonnen Habtemichael Berhe	M.Tech	Green Methodologies for Synthesis and Application of Dyes
Karishma Shah	M.Tech	Effective application of citrus peels derived peroxidase on effluent treatment and synthesis
Mimoh Devdas Koli	M.Tech	Titanium based catalyst for Oxidation Of Industrial Effluent
Surabhi Sunil Choudhary	M. Tech	1, 8- Cineole Derivatives using deep eutectic solvent and formulation of fragrance blends

Vaibhav Patil	M. Tech	Green synthesis and application of perfumery and
flavor compounds		
Dharit Shaha	M. Tech	Disperse Dyes containing Thiazole Unit and Acid dyes
Yeshiemebet Walle	M. Tech	Synthesis of Phthaimide Based Azo Disperse Dyes and Thiazole Containing Acid Dyes

RESEARCH ABSTRACT:

Research Scholar: Mr. Pravin Nimba Borase
Research Supervisor : Prof.(Dr.) Ganapati Subray Shankarling
Degree Awarded : Ph.D. (Science)

Thesis Title : Synthesis of novel heterocyclic colorants and supramolecular host for high-tech applications

The research work pursued describes the designed and synthesis of a novel Schiff base receptor, dihydroquinazolinone fluorophore and development of greener synthetic methodologies for the nitrile and amide derivatives. The supramolecularly assisted host-guest interactions between the chromophoric and fluoregenic organic receptors and metal ions (e.g. Al^{3}+, Cr^{3}+, Fe^{3}+ and Cu^{2}+) were manifested. Subsequently, the supramolecularly assisted host-guest interactions between macrocyclic host Cucurbit[7] uril and the feebly fluorescent probe will be conferred. A main objective of the studying these host-guest interactions was developed a novel cost-effective metal ion sensors. Which will be an alternative tool for existing sophisticated analytical techniques for detection of metal ions. For the synthesis of organic receptors, we have used the environmentally friendly aspects of the green chemistry.

The Schiff base receptor showed a significant advantage of naked eye detection of micro-molar level Al^{3}+, Cr^{3}+ and Fe^{3}+ ions. Along with this, we have also studied the practicability of this receptor. We have proposed a Boolean type molecular logic gate system which will explore the possibility of mimicking the INHIBIT type of logic gate at the molecular level.

Host-guest interactions between the dihydroquinazolinone (QZP) fluorophore Cu^{2}+ ions are studied in thoroughly. The practical applications of the sensor QZP have also been demonstrated for detection of Cu^{2}+ in aqueous media by using filter paper strip, TLC plate and solid silica support method. The complexation was proven by ESR and Single crystal X-ray analysis.

Along with this, we have studied the Supramolecular interaction between macrocyclic host cucurbit[7]uril and the feebly fluorescent guest was manifested using absorption, steady-state, time-resolved fluorescence and 1H NMR spectroscopic techniques and quantum chemical calculations were performed to understand the binding energy and of the complex. The effect of temperature and pH was on binding affinities of the probe were investigated.

We have also explored the biodegradable choline hydroxide as a homogeneous basic ionic liquid catalyst. The simple, metal and ligand-free protocol for the synthesis of 2,3-dihydroquinazolin-4(1H)-ones derivatives using choline hydroxide (ChOH) as an effective catalyst in an aqueous medium has been discussed in detail. We have also explored the synthetic utility of Ru-(salen)-bis-aqua catalyst for the direct transformation of aldehyde to nitrile and amide derivatives in an aqueous medium. The higher turnover number signifies that the catalyst is robust in nature

Research Scholar: Mr. Saurabh Deshpande
Research Supervisor: Prof. (Dr.) Ganapati Subray Shankarling
Degree Awarded: Ph.D. (Science)

Thesis Title: Synthesis of Spiropyrans, phenothiazine based functional colorants and utility of green methods for organic synthesis

Spiropyrans are dynamic robust molecules which can

undergo reversible structural isomerization from closed Spiropyran (SP) to open Merocyanine (MC) form upon irradiation with light. The structural isomerization from one form to another results in the change of colour from colorless to color with due reversibility upon irradiation of visible light or using the surrounding energy. The photoisomerisation results in the formation of two different forms which differ vastly in their properties making them to act as a photoswitch. In fact, spiropyran is far more than just a simple photoswitch; the range of stimuli able to induce its reversible isomerization is truly impressive and includes different solvents, metal ions, acids and bases, temperature, redox potential, and mechanical force, etc. This versatile input method highlights the far-reaching capabilities of new spiropyran-based dynamic materials. In one part of our project, we have designed a photoswitch attached to the boranil, a recently developed fluorophore with an intention to design a Photochrome-Fluorophore conjugate. Such conjugates are known to exhibit Fluorescence Resonance Energy Transfer (FRET) a phenomenon widely applied to reduce the diffraction barrier resulting in the increase in resolution of Fluorescence microscopy. Spiropyrans are dynamic molecules which can result in opening of ring under the influence of metal ions. This enables us to exploit one of the wide properties of SP in the application of Metal ion sensor. In our quest, we have successfully synthesized, characterized a novel SP which can detect heavy metal Pb2+ up to nanomolar concentrations. Further, we have also focused on the styryl dyes synthesis due to their numerous applications in the field of OLED's, mechanophores, photosensitizers, metal ion sensors, etc4 . Here in, we have utilized in house synthesized acceptor thiazoloquinoxalines and have prepared a novel styryl dye involving Phenothiazine as a donor. The excited state dynamics of these dyes were studied from the photophysical studies and the time correlated single photon counts (TCSPC). We have successfully employed a phenothiazine based dye as a chemo dosimeter for the detection of Cu2+ ions. The detection limit of these dyes were found to be in micro molar levels. The chapter 1 is a review of the recent development and applications of several Spiropyranfluorophore conjugates which exhibit FRET phenomenon. Chapter 2 and 3 deals with synthesis of novel PcFRET system involving spiropyran and Boranil as a fluorophore and their photophysical properties as a FRET conjugates. Chapter 4 discusses about the design and the synthesis of novel spiropyran for metal ion sensing and DFT study of the newly synthesized molecule while Chapter 5 involves its application as a photo reversible switch for the detection of Pb2+ ions. The synthesis of Phenothiazine based dyes conjugated to strong acceptors such as thiazoloquinoxalines and benzindolino moieties and the extensive photophysical studies have been carried out in chapter 6. Chapter 7 involves application of one of the dye synthesized in the previous chapter for the selective detection of Cu2+ ions acting as a chemodosimeter. Chapter 8 deals with the synthesis and photophysical properties of Phenothiazine-thiazole based dyes for FMR and AIE studies. Chapter 9 includes Choline Chloride: Oxalic acid Deep Eutectic Solvent (DES) as an efficient catalyst for the selective synthesis of 2-Aryl-1-arylmethyl-1H-benzimidazoles and chapter 10 involve energy efficient, clean and solvent free photochemical benzylic bromination using NBS in concentrated solar radiation (CSR)

Research Scholar:
Mr Mekonnen Habtemichael Berhe
Research Supervisor: Prof. (Dr.) Ganapati Subray Shankarling
Degree Awarded: M.Tech

Thesis Title: Green Methodologies for Synthesis and Application of Dyes

The aim of this work was to analyse the dyeing of polyester fabric by using disperse dyes in the presence of recyclable and eco-friendly choline chloride based deep eutectic solvent (DES) as the main additives without using any dispersing and levelling agents. The result obtained shows dyeing of polyester fabric at 105°C in the presence of DES gives better color value (K/S) and

fastness value than that of the conventional dyeing method at 130°C, and the choline chloride: Urea DES was recycled five times without severe impact on its activity. This dyeing process of polyester fabric was a promising alternative for process optimization like energy, dyeing time, water consumption, chemicals, auxiliaries used and on developing eco-friendly textile processing.

Choline hydroxide ionic liquid was successfully used as fixating agents in dyeing of cotton with reactive dyes. In this work we use small amount of choline hydroxide ionic liquid in the presence of organic and inorganic salts for exhaustion, and effect of both choline hydroxide and a biodegradable organic salts like disodium citrate, tetra sodium (Ethylenediaminetetraacetic acid) was compared with that of the conventionally dyed fabric. The results shows the fabric dyed with the presence of choline hydroxide ionic liquid had a better and comparable color value (K/S) than the fabric dyed with conventional method and the washing and light fastness are relatively better. In addition the amount of the total dissolved solid and the biological oxygen demand in the dyebath are much lower than that of the conventional process. The choline hydroxide ionic liquid was reused four times from the dyebath without significant effect on K/S value and fastness properties, which have benefits in maximum conservation of water, contributes for high reduction of effluent loads and for developing eco-friendly textile processing. This process will be one approach to develop eco-friendly process by reducing the environmental load in textile processing.

In this research work we have prepared different DES like choline chloride urea, choline chloride malonic acid, choline chloride oxalic acid, choline chloride tartaric and choline hydroxide ionic liquid. During the synthesis of anthraquinone acid dyes by Ullmann condensation I used choline hydroxide solvents instead of DMF and other catalysts, the result shows the IL used enhance the catalytic activity of the reaction with good yield. Different bisazo dyes and monoazo disperse dyes was synthesized during my research work and their application study with DESs shows it is a promising approach to develop green textile dyeing processes. These DESs was then used to get desired product in high yield with maximum purity, in less reaction time, and for optimising the dyeing process.

Research Scholar: Mr. Pritesh S. Patil
Research Supervisor: Prof. (Dr.) Ganapati Subray Shankarling
Degree Awarded: M.Tech

Thesis Title: Green synthetic method for synthesis of anthraquinone derivatives and hydroxymethylation of phenol derivative

The efficient protocol involving naphthoquinone, 2-butenal and p-toluene sulfonic acid (PTSA) were carried out in presence of the organocatalyst L-proline in aqueous medium at reflux. The one pot synthesis protocol offers good to excellent yield of desired product.The protocol reported here is benign to the environment as water is used as the solvent. The organocatalyzed benz-annulation in water was applied successfully for the synthesis of various anthraquinones derivatives. The one pot synthetic protocol of hydroxymethylation of phenol derivatives offers good to excellent yield of desired product. The simple, green and commercially viable protocol involves substituted phenols, formaldehyde in choline hydroxide were successfully carried out in choline hydroxide at 80°C. The protocol mentioned here is benign to the environment as choline hydroxide used as solvent as well as catalyst.

Research Scholar: Miss. Karishma Shah
Research Supervisor: Prof. (Dr.) Ganapati Subray Shankarling
Degree Awarded: M.Tech

Thesis Title: Effective application of citrus peels derived peroxidase on effluent treatment and synthesis

The present study aims to investigate the application of peroxidase enzyme extracted from citrus limon peels using ultrasound for synthesis and effluent treatment. The goal was to optimize the ultrasound-

assisted extraction time to achieve maximum recovery of peroxidase from citrus peel with the most desirable enzyme specific activity and stability. The application of extracted enzyme for effluent treatment was screened using OFAT methodology. The maximum decolorization of 10 mg/L Rhodamine B color was accomplished at 44.66 U/mL of catalyst. Treatment of Industrial effluent accomplished tremendous COD reduction by enzymatic treatment individually. Combination of existing methods with enzymatic method proved to be efficient in reducing COD of CETP effluent within permissible limits. Peroxidase is an efficient catalyst used in oxidation of o-phenylenediamine in presence of hydrogen peroxide that yield 70.10 % of 2, 3-diaminophenazine. The structure of synthesized compound 2, 3-diaminophenazine was affirmed by FTIR spectroscopy

Research Scholar: Mimoh Devdas Koli
Research Supervisor: Prof. (Dr.) Ganapati Subray Shankarling
Degree Awarded: M.Tech
Thesis Title: Titanium based catalyst for Oxidation Of Industrial Effluent

Present study demonstrates effective a plication of titanium dioxide on effluent treatment from different source. The influence of various parameters, such as catalyst loading, pH and time on the degradation process was examined. 96.87% COD reduction of Industrial effluent and 72% COD reduction for styryl dye effluent was achieved under optimized condition. Titanium superoxide catalyst was successfully prepared, and applied for dye degradation. Complete decolorization of Acid Orange 7 was obtained under optimized conditions. Titanium superoxide catalyst was effective for four consecutive cycles. Application of titanium superoxide on CETP effluent were also carried out in combination with other methods in order to examine the effectiveness of the method to a more complex waste.

Research Scholar: Miss. Surabhi Sunil Choudhary
Research Supervisor: Prof. (Dr.) Ganapati Subray Shankarling
Degree Awarded: M.Tech
Thesis Title:1, 8- Cineole Derivatives using deep eutectic solvent and formulation of fragrance blends

1, 8- Cineole is the main volatile component present in the essential oil extracted from the eucalyptus plant and is responsible for imparting eucalyptus oil with its characteristic aroma and flavour. The present study involves synthesis of various chemical compounds from 1, 8- Cineole using Deep Eutectic Solvent. The Deep Eutectic Solvent was prepared from choline chloride and malonic acid. Gas chromatography-mass spectrometry technique was used to analyse the products and three of the products were identified as α-Terpineol, Limonene and α-Terpinene. The present research project also studies one of the most important aspects in the Perfumery industry that is, Formulation of Fragrance Blends. 10 fragrance blends were formulated and were studied for their shelf life, sensory evaluation, retentivity and microbial analysis among others. The fragrances were also subjected to application studies and were incorporated in consumer goods like fine fragrances, incense sticks and hair tonics. A case study regarding the costing of a fragrance blend was also completed.

Research Scholar: Mr. Vaibhav B. Patil
Research Supervisor: Prof. (Dr.) Ganapati Subray Shankarling
Degree Awarded: M.Tech
Thesis Title: Green synthesis and application of perfumery and flavor compounds

The objective of this work is to synthesize perfumery and flavor compounds employing green and synthetic route and study their activity and efficacy. In current era, green reaction medium for organic synthesis is highly demanding. Choline hydroxide a new deep eutectic solvent obtained by reaction of choline chloride and potassium hydroxide has several advantages in terms of availability, low price, biodegradability and environmentally benign features. We have developed a simple, green and efficient catalytic system using choline hydroxide mixtures for rapid

synthesis of perfumery and flavour compounds. The reaction is carried out using 100% choline hydroxide which acts as solvent as well as catalyst. All the reactions carried at room temperature except one reaction of hexyl cinnamaldehyde which was carried out at reflux temperature. Following this protocol, 9 aroma compounds were synthesized and characterized using GC,GCMS, FTIR and NMR. The reaction gave good conversion of reactants and synthesized compounds have good olfactive properties that can be used for fragrance formulation. The reaction showed a marked improvement over reported method by NaOH. Good yields were obtained in the range of 70-85%. To the best of our knowledge, this is the report of a catalyst that can effectively catalyze these two important C-C bond formation reactions. In addition the choline hydroxide catalyst could be easily recycled and reused for at least three runs without any considerable loss in yields. Olfactive properties of these compounds have been checked. Out of them cinnamaldehyde derivatives found spicy kind of odourprofile and raspberry ketone derivatives found fruity and spicy kind ofodour profile. Out of this few were used in candle fragrance formulation.

Research Scholar: Mr. Amol jadhav
Research Supervisor: Prof. N.Sekar
Degree Awarded: Ph.D. (Science)

Thesis Title: Synthesis and functional applications of Benzophenone and Xanthene based derivatives

Benzophenone and xanthene based dyes are considered to be important class of colorants. Both benzophenone and xanthene units are symmetrical functional isomers having molecular formula C13H10O. So, even one alternation on either side of the moiety provide positions with different electron density to alter the photophysical properties giving an array of different functional compounds. Such versatility of both benzophenone and xanthene units make them applicable in wide variety of areas such as photoinitiators, photosensitizers, UV-stabilizers, oxidants in Photoinduced Eletron Transfer (PET), biological probes, fluorescent chemosensors, Organic Light Emitting Diods (OLED), Thermally Activated Delayed Fluorescence (TADF) and phosphorescnece. In spite of having high quantum yields and high molar extinction coefficients of reported Xanthene based (Rhodamines) and coumarin dyes, they have very small Stokes shift. Similarly, reported benzophenone based dyes are having good Stokes shift but low quantum yields. Therefore synthesis of new benzophenone and xanthene derivatives and their functional applications is of great interest. So, we have tried to achieve better quantum yields in benzophenone based dyes by means of incorporating good donors and stabilizing groups to make them highly fluorescent for functional applications. We have also synthesized analogues of Rhodamines dyes and coumarin derivatives having very good Stokes shifts.

Research Scholar: Mr. Ankush More
Research Supervisor: Prof. N.Sekar
Degree Awarded: Ph.D. (Science)

Thesis Title: BODIPY dyes-Synthesis, Photophysical properties and DFT studies.

This research thesis provides insight into the chemistry of the BODIPY family and OBO complexes of the fluorophores. It describes the synthetic methods undertaken to attempt various structural modifications of the core BODIPY framework.

The work describes an efficient and chemoselective protocol to substitute the F atoms of the BF2-BODIPYs to the corresponding Et2B-BODIPYs and regeneration of the BF2-BODIPYs again from the Et2B-BODIPYs with high yield. Subsequently we have presented synthesize of substituted BODIPY dyes and the effect of substituent on the photophysical properties of the fluorophore. It was hypothesized that linking the acetyl acetone moiety at the beta position of the BODIPY core would extend electronic conjugation to influence its fluorescence significantly. Such dye can be used as an "ON-OFF" fluorescent sensor of the Cu2+ ions due to formation of a stable non-fluorescent Cu2+-complex. Also, the resultant non-

fluorescent Cu2+: BODIPY-acac complex may be attractive in detecting some toxic anions (S2-) by the displacement approach.

Further we have presented an effective synthesis of efficient pyrene based NLO chromophores- A) To study the photophysical properties of newly synthesized chromophores to construct the solvatochromism based polarity function plots to establish the charge transfer (CT) characteristics, B) utilization of the different CT characteristic parameters to evaluate the solvatochromic nonlinear optical properties of donor pi acceptor (D-pi-A) chromophores and C) to support the solvatochromic NLO properties by DFT analysis using computational approach

Research Scholar: Mr. Santosh kataria
Research Supervisor: Prof. N.Sekar
Degree Awarded: Ph.D. (Science)

Thesis Title: DFT Studies On Fluorophores With ESIPT And Large Hyperpolarisabilities

Donor acceptor chromophores have emerged as important materials for organic electronics due to their invariably high nonlinear optical (NLO) response. They have several advantages over inorganic NLO materials. Assessing the NLOphoric properties of donor -acceptor or push-pull chromophores involve a heavy investment in experimental set up.

Density Functional Theory (DFT) deals a good accuracy and computational cost ratio among various methods used to predict the electronic structure of molecules of practical interest. The triphenylamine, a unique and extensively accepted donating group for its better electron donating ability. The charge transfer characteristic has been used in opto-electronic applications. Different triphenylamine based dyes are selected and their detail photophysical properties, intramolecular charge transfer characteristics and linear as well as nonlinear optical properties in different solvents are studied. Three different types of triphenylamine based dyes studied with varied acceptors by estimating HOMO-LUMO energy gap and they were extensively studied for their linear as well as non-linear behavior.

Comparative study of nonlinear optical properties of red emitting coumarins has been done with DFT using global hybrid (GH) and range-separated hybrid (RSH) functionals and correlated with the spectroscopic values. The GHs - BHHLYP, PBE0, M06, M06L, M062X, and M06HF and RSHs - CAM-B3LYP, HISSbPBE, HSEH1PBE, wB97, wB97X, and wB97XD in combination with 6-311+G(d,p) basis set have been tested. Estimated polarizability (αCT), first order hyperpolarizability (β0) and second order hyperpolarizability (γ) from the RSHs were closer to the values compared to GHs. However extensive benchmarking of computational strategies is needed before the design strategies are finalized.

The photo-physical behavior of 5, 6-dichloro-1, 3-bis (2-pyridylimino)-4, 7-dihydroxyisoindole was studied using the density functional theory (DFT) and time-dependent density functional theory (TD-DFT). The functional used was B3LYP and 6-31G (d) was the basis set for all the atoms. All the ten tautomers were studied for the absorption and emission properties. It was found that the tautomer where hydroxyl groups are syn to the nitrogen of isoindoline ring is most stable and thus, responsible for the ESIPT process.

Research Scholar: Mr. Shantaram Kothavale
Research Supervisor Prof.N.Sekar
Degree Awarded: Ph.D. (Science)

Thesis Title: Donor-Acceptor and ESIPT based fluorescent colorants: Synthesis, photophysical and DFT computational studies

Donor-acceptor compounds with extended π-conjugation have been used to reduce the HOMO-LUMO energy gap and are extensively studied for their linear as well as non-linear behaviour. Different phenanthroline supported donor-π-acceptor pyrazine compounds, decorated with naphthalene, acenaphthene and phenanthrene core are synthesized and studied for

their highly solvatochromic as well as acidochromic behaviour. Depending on the length of conjugation and availability of different positions for protonation positive as well as negative acidochromism is observed.

Fluorescent molecular rotors (FRMs) are micro-environmental sensitive molecules and are applicable as sensors to sense slight fluctuation in pH, viscosity, polarity, voltage and presence of specific analytes. NIR fluorescent probes are attractive for biological applications because of minimum photo damage to biological samples, deep tissue penetration, and minimum interference from the background auto fluorescence. Triphenylamine based coumarin-rhodamine fused hybrid dyes are synthesized and studied for their improved photophysical properties as well as viscosity sensitivity.

Triphenylamine, a unique and widely accepted donating group for its very good electron donating ability and charge transfer characteristic has been used in obtaining dyes for opto-electronic applications. Different methoxy supported triphenylamine styryl dyes are synthesized and their detail photophysical properties, intramolecular and twisted intramolecular charge transfer characteristics in different solvents are studied. Different bis and tris-substituted triphenylamine based rhodamine as well as coumarin-rhodamine derivatives are successfully synthesized, characterized and studied for their improved photophysical properties and increased Stokes shift as compared to the reported rhodamine dyes.

Excited state intramolecular proton transfer (ESIPT) compounds are applied as UV photo stabilizers, proton transfer lasers, photo switches or fluorescent probes. Specifically Hydroxyl-substituted tetraphenyl imidazole (HPI) have been successfully employed as laser dye, organic light emitting materials including white light and as emission colour tuning material. Effect of different donating groups on HPI as well as phenanthrene core was studied and found to show combined effect of intramolecular charge transfer (ICT) with ESIPT to exhibit interesting photophysical results.

Research Scholar: Mr. Shrikant thakare
Research Supervisor Prof.N.Sekar
Degree Awarded: Ph.D. (Science)

Thesis Title: Design and Synthesis of Novel BODIPY Fluorophores, Photophysical Properties and DFT Studies

Abstract

BODIPY (4,4-difluoro-4-bora-3a,4a-diaza-s-indacene) dyes constitute a fascinating topic of research in the area of fluorescence colorants due to its huge and variety of application. BODIPY dyes are attractive due to their excellent photo-physical properties and potential for fluorescence-based sensing and bio-imaging and optoelectronics applications. Indeed, one can find a huge library of compounds based on the BODIPY framework. The versatility of this fluorophore lies in its tunable spectroscopic properties with high molar absorptivity (up to 80000 M-1) in the visible and NIR region which gives intense absorption bands and high fluorescence quantum yields due to the rigidity of the core and low intersystem crossing (ISC) and internal conversion (IC) rates. The rigidity of the core due to BF2 moiety which allows pi-electron delocalization that makes it a pseudo-aromatic compound which provides the thermal and photochemical stability to this fluorophore. Researchers have extensively explored this fluorophore by modifying at α, β, meso and also the boron centre to improve its applicability along with the stability. These dyes can easily be tuned at a desired wavelength by altering the HOMO-LUMO band gap with appropriate core substitution. BODIPY dye shows less stokes shift due to minimum charge separation over the molecular structure, which sometimes makes this dye less useful due to self-reabsorption process. So, the choice of the proper donating group which gives large charge separation over the molecule is of great importance to produce highly stokes shifted red emission. Based on this strategy BODIPY dyes are well explored for their applications in metal

sensors, pH sensors, molecular rotors, biomolecule labelling and fluorescence imaging. The main objective of the present research work is to synthesis and to study the photophysics of the BODIPY dyes in terms of their excited state charge transfer processes with steady state and time-resolved spectroscopic techniques along with quantum chemical calculations to support the hypothesis.

Research Scholar: Mr. Yogesh Gavale
Research Supervisor: Prof. N.Sekar
Degree Awarded: Ph.D. (Science)

Thesis Title: NIR absorbing aza-BODIPY dyes and dyes based on 2H-pyrido[1,2-a] pyrimidine-2,4(3H)-dione- Synthesis, functional applications and DFT studies

Aza-BODIPY is a versatile fluorophore due to its spectral tunability with high molar absorptivity in the NIR Region. The fluorescence quantum yields of these dye are low due to the higher intersystem crossing (ISC) and non-radiative decay (Knr) rates. These chromophores have good solubility in an organic medium. The rigidity of the core due to BF2 moiety which allows pi-electron delocalization providing required photostability. These fluorophores have been extensively explored by modifying the core and peripheral positions. These dyes can easily be tuned at a desired wavelength by altering the HOMO-LUMO band gap with appropriate core substitution. Like BODIPY the aza-BODIPY dyes show less Stokes shift due to minimum charge separation over the molecular structure, which sometimes makes this dye less useful in the biology due to selfreabsorption

process. So the choice of the proper donating group at peripheral position and functional group at

core position which gives large charge separation over the molecule and enhance the intersystem crossing rate is of great importance to produce large Stokes shifted red emission and high triplet quantum yield. Based on this strategy the aza-BODIPY dyes are well explored for their applications as triplet photosensitizers for photodynamic therapy and photoacoustic contrast agent for photothermal therapy. The main objective of the present research work is to investigate the efficiency of singlet oxygen generation of triplet sensitizer aza- BODIPY derivatives using DPBF trap degradation experiment, determination of triplet quantum yield using Nano Second Laser Flash Photolysis, and it's in vitro application with chicken tissues along with quantum mechanical calculations to support the hypothesis. 2H-pyrido[1,2-a] pyrimidine-2,4(3H)-dione is one of the important N-heterocycles that has a privileged positions in drug discovery. In particular, research interest in utilizing pyridopyrimidine motif as an important intermediate has rapidly grown due to their biological and biomedical applications particularly antibacterial, antimicrobial, anti-allergic, tyrosine kinase, antitumor, anticonvulsant, and antifolate. Due to the free nucleophilic site available on 2H-pyrido[1,2-a]pyrimidine-2,4(3H)-dione, it is available for the synthesis of azo dyes which involves diazotized aromatic amine sulphonic and carboxylic acids as electrophile. Hence the

series of azo acid dyes have been prepared using reaction between 2H-pyrido[1,2-a] pyrimidine-2,4(3H)-dione as coupler and diazotized aromatic amine sulphonic and carboxylic acids as diazo component. Synthesized dyes were characterized by spectroscopic techniques. These azo acid dyes were applied on various textile substrates whereupon their fastness properties, color assessment were evaluated. 2H-pyrido[1,2-a]pyrimidine-2,4(3H)-dione can undergo Pechmann condensation to yield fluorescent 4- methyl-2H,5H-pyrano derivatives of 2H-pyrido[1,2-a]pyrimidine-2,4(3H)-dione. These dyes have absorption and emission respectively in the range of 350-370 nm and 400-425 nm suggesting their potential application as fluorescent whitening agents. Due to the specific absorption and emission properties, these dyes were applied to polyester fabric and their performance was evaluated by means of measuring the degree of whiteness, the degree of brightness, and color values in

comparison with a commercially available fluorescent whitening agent, Hostalux ESR.

Research Scholar: Mr. Umesh Warde
Research Supervisor: Prof. N.Sekar
Degree Awarded: Ph.D. (Science)

Thesis Title: Naphthalene based functional colorants: Synthesis, Photophysical and DFT Studies

Functional colorants are the inorganic or organic compounds which have functional applications. Among those, organic compounds have intrinsic photochemical and photo-physical properties. Organic functional colorants are divided into two parts. First is fluorescent colorants and other is non-fluorescent colorants. Non fluorescent colorants contains compounds which are themselves are colored and shows visible colors on substrates such as fabrics, papers and metals. The fluorescent compounds show colors on emission in the specific region of electromagnetic radiation. These compounds show enhanced fluorescence emission (high quantum yield or large Stokes shifted fluorescence or both) regarding various phenomenon's and hence are of prime importance in many technological applications such as sensitizers, information storage (compact disc technology), optical brighteners, optoelectronics as OLED, LASER, Solar cells and as a fluorescent probes for many biological species (ions, radicals biomolecules etc.) and also in modern medicine (photodynamic cancer therapy).1,2

But still the practical applications are limited. These applications need molecular and protocol simplicity. They require compounds of good photostability, thermal stability, high quantum yield and large Stokes shift. To quire all these qualities in a single compound is a difficult task. But as science doesn't stop and wants to continuously grow, synthesis and study of novel fluorescent compounds become very important.

Among the various concepts studied for photophysical properties of the functional colorants, the Excited state intramolecular proton transfer (ESIPT) and the intramolecular charge transfer (CT) have gained scientific interests since last 50-60 years.3,4 The ESIPT molecules have two major advantages. First is high light stability and second is large Stokes shifted emission. This dynamic property gave the ESIPT molecules the place in the functional colorants category.5,6 The charge transfer compounds are the compounds where there is a flow of electrons from electron rich centre to electron deficient centre. This implies the stabilization of excited state before the compound emit the light. This stabilization differs according to the environment (solid or solution). In solution, charge transfer makes molecule to show solvatochromism. This solvatochromism and dependence of charge transfer in changing environment made charge transfer molecules the topic of research for highly functional applications such as OLED, non-linear optical properties etc.7, 8

In the present work we studied the ESIPT phenomenon and charge transfer phenomenon of some novel molecules based on single scaffold. This is the reason, we chosen the Naphthalene core. Naphthalene is quite a stable molecule compared to Benzene which has low stability. It has double resonance energy (61 kcal/mol) than the benzene (36 kcal/mol). Naphthalene is versatile for the different substituents. It has the extra positions to allow many useful modifications in the molecules compared to benzene. In case of naphthalene not all the bonds are equal unlike benzene. This suggests the different charge distribution in the molecules which can make the molecule to behave differently having same functionality on different positions.9

Considering all these points we have developed the three novel molecules based on ESIPT concept. We have studied the ESIPT dynamics of these molecules and their improved emission profiles in aggregate state and viscous state. We have studied their molecular structures with help of density functional theory and their vertical excitation properties. Five novel azo compounds having negative solvatochromism and improved

light and washing fastness were developed and studied. Three novel coumarin molecules based on charge transfer concept having naphthalene core (benzocoumarins) were developed for their study in nonlinear optical properties. Finally the four charge transfer benzocoumarin-styryl hybrid compounds were also developed. Their photophysical properties deeply investigated and also compared with the computational results using DFT and TD-DFT methods.

To serve as a strong backbone for our study we have provided reviews for every chapter in this work.

THE DEPARTMENT IS EQUIPPED WITH A FUNCTIONAL ORGANIC SYNTHESIS LABORATORY. FACILITIES INCLUDE:

- Autoclaves, Hastelloy – 300 mL, 1 lit
- Autoclaves, SS 316 – 3 x 600 mL, 5 lit
- Pressure reactor
- Glass assemblies
- Julabo
- Lyophilizer / Freeze dryer
- Ice-Machine
- Oven
- Microwave reactors
- Parr hydrogenators – 300 mL, 600 mL
- Rotary evaporators
- High vacuum pump
- Chemical Vapor Deposition
- Centrifuge Machine
- Ultra Sonicator

THE FOLLOWING ANALYTICAL INSTRUMENTS ARE AVAILABLE:

- Gas Chromatography (GC)
- HPLC
- FTIR
- UV-Visible Spectrophotometer
- Spectrofluorimetry
- Particle size analyzer
- Simultaneous DSC – TGA i.e. Thermo gravimetric analyzer
- 500 MHz NMR (Sanctioned under Prime Minister's Project).
- Cyclic Voltammetry

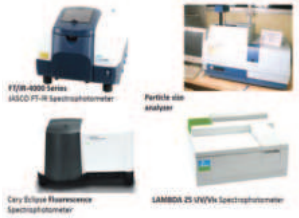
THE PIGMENT HOUSE IS EQUIPPED WITH:

- Analytical mill and homogenizer
- Automatic draw down assembly
- Automatic pigment Mueller
- Automatic vibroshaker
- Ball mill
- Kneader
- Mars mill
- Planetary ball mill
- Sand mill

LABORATORY PHOTOS


Agilent 500MHz NMR


Gas Chromatography with Auto-sampler




Flash Chromatography Smart Flash EPCLC AI-580S Yamazen


Preparative HPLC


Rotary Evaporator

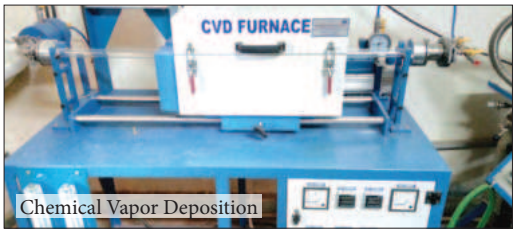

DSC-TGA Instrument


Lyophiliser

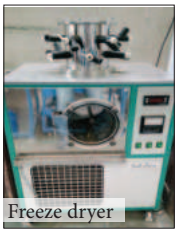
HPLC instrument


Julabo

Cyclic Voltammetry

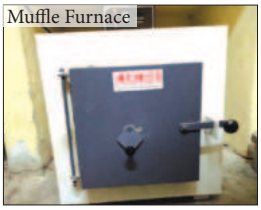


Chemical Vapor Deposition


Freeze dryer


Centrifuge Machine


Ultra Sonicator


Muffle Furnace


Vaccum oven

RESEARCH GROUP

DR. G. S. SHANKARLING RESEARCH GROUP

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Centre: Dr. Satyajit Saha,
Right: Dr. Rajpratap Kshatriya (Research Associate)

DR. NABANITA RESEARCH GROUP

From left: Mr. Chinmay Thakkar (Project Assistant), Dr Nabanita Sadhukhan (Mentor), Ms. Criss Dcosta (JRF), Ms. Tanvi Gupta (Ph. D.)