Photochromic Molecules and Materials for a Sustainable Future

Course Overview:

Light is a fascinating reagent: It can penetrate matter und provide the energy for chemical transformations. The reversible isomerization of molecules by light of different wavelength (photoswitching) is a well-studied phenomenon, which recently found wide applications. Photochromic molecules are used to construct light-responsive materials or surfaces and are used as remote-controllable probes or modulators for biomedical or diagnostic applications. Engineering of advanced molecules and supramolecular assemblies require a variety of modules with specific functions and properties. Redox activity is an example of an important function, which allows charging of the organic molecules, either by removal or donation of electrons. Π-Conjugated molecules are often redox active and are conveniently used as wires for electron transport (conductance). Building blocks that can absorb and emit light at specific wavelengths (chromophores and fluorophores) or that can undergo light or thermally induced structural changes (photo/thermoswitches) to form molecules with new properties and also for energy production are being explored today. Examples are vibrant where structural motifs allow complexation of specific guest molecules or ions in various media via noncovalent interactions. Such molecular hosts may concomitantly act as catalysts for the chemical conversion of the guest molecules, formulating energy transformation converting substrates into new product, thereby mimicking site specific enzymes, or they could act as carriers for transporting the guest molecules from one phase to another, for example, through a cell membrane and also thus accomplishing Bioengineering. Photoswitches (or photochromic molecules) that upon irradiation undergo conversion to an isomeric structure are employed for variety of applications, ranging from molecular switches for data storage, molecular electronics, light-controllable liquid crystals, light-controllable membrane proteins and nanomachines. The year 2012 marked the centennial anniversary of a now-famous article titled " The photochemistry of the future," in which the pioneering chemist Giacomo Ciamician challenged the scientists of his day to imagine a chemical industry that could synthesize chemicals in the same manner that plants do—by using sunlight as a safe, inexpensive, abundant, and renewable source of chemical potential . 2015 is the International year of Light.

The participants will learn these topics through lectures and hands-on experiments. Also assignments will be shared to stimulate research motivation of the participants.

Modules	**14 th Feb 2019 to 18 th Feb 2019** **Number of participants for the course will be limited to First Hundred.**
You Should Attend If…	▪ You are a B.Sc/ M.Sc or Ph.D. in Chemistry , Physics, Life Sciences ▪ You are a B.Tech/ M.Tech/ M.Tech (Research) in Chemical Engineering, Ceramic Engineering, Metallurgy and Material Engineering ▪ You are a faculty from academia interested in learning research for sustainable future. ▪ You are a synthetic chemist or Chemical Engineer ▪ You are a Material Chemist interested in designing materials ▪ You are a NanoTechnologist or a biotechnologist ▪ You are from a Chemical Industry ▪ You have done a degree in Agriculture ▪ You have a passion to undertake a career in Chemical, Pharma, oil Company
Participation Fees	▪ Abroad Participants: US $ 300 ▪ Industry Personnel: Rs. 4000 ▪ Faculty From Academic Institutes/ Research Institutes: Rs. 2500 ▪ Students from Academic and Research Institutes: Rs. 1200 ▪ Students from Host Institute: Free *The student participants will be provided with accommodation and fooding on payment basis.*

The Faculty

Prof. Burkhard Koenig

Universität Regensburg, Germany
E-mail: Burkhard.Koenig@chemie.uni-regensburg.de

Prof. Koenig is serving many key positions now like Editorial board member of "Chemistry – A European Journal" and "European Journal of Organic Chemistry (since 2014) UN-Decade Award on Sustainability 2011/2012, Dean of the faculty of chemistry since 10/2011. Some of his notable awards comprise of Literature award of the Fonds of the German Chemical Industry 2007, Chairman of the Liebig Vereinigung (National organic devision; 2008 – 2012), Member of the excecutive board of the German Chemical Society (2004 - 2007), Chairman of the „Arbeitsgemeinschaft Deutscher Universitätsprofessoren Chemie (ADUC)" (2005-2007), Member of the International Advisory Board of the Institute for Organic Chemistry and Biochemistry of the Czech Academy of Sciences and many more. For details please visit his website. **http://www-oc.chemie.uni-regensburg.de/koenig/**

Course Co-ordinator

Dr. Debayan Sarkar

Associate Professor,
Department of Chemistry,
Email: sarkard@nitrkl.ac.in

Prof. Sarkar is presently an Associate professor at the Department of Chemistry, NIT, Rourkela, India. His research interest include Dearomatization reactions and Atom-economic transformations. He has completed his Ph.D from Indian Association For The Cultivation of Science (IACS) in the year 2011, with Prof. R. V.Venkateswaran. After that he travelled to carry out his post-doctoral studies at Stanford University (USA) under the mentorship of Prof. Barry M Trost. He has been recently deputed as a Visiting Senior Assistant Professor at Graduate School of Pharmaceutical Sciences,Tohoku University (Japan) under the mentorship of Prof. M. Yamaguchi (Dec 2015- March 2016). He has been recipient of prestigious awards like DAAD-Research Stay Award 2018, Inspire faculty award(2013), BRNS-DAE Young Scientist Award(2014), Indo-US Research Award(2012).For more details please visit his website. **http://www.nitrkl.ac.in/CY/~sarkard/**

Prof. Subrata Ghosh, J C Bose National Fellow, FNA, FNASc (IACS, Kolkata) will be our honoured Guest and deliver a lecture to the audience in this occasion.

Step 1:

One Time Registration with the GIAN web portal of IIT Kharagpur using the following steps:

a) Create login and password at:

http://www.gian.iitkgp.ac.in/ccourses/approvecourses3

b) Complete the personal details and pay **Rs. 500/- (non refundable) through the online payment gateway.**

c) Select the Course(s) you are interested in.

d) Confirm your application.

e) Download and print "pdf file" of your enrolment application form for your personal records and copy of the same to be sent to the Course Coordinator.

Step 2:

Course registration with the course coordinator.

Once the course coordinator shortlists the applicant in the GIAN web portal, an email will be sent to him/her. **He/she then may proceed for the course registration by filling out the course registration form and paying the below prescribed participation fees**.

Participation fee can be sent in the form of demand draft (D.D.) drawn on any nationalized bank in favor of **"Continuing Education, NIT Rourkela"** payable at Rourkela. The above fee includes teaching materials only. The participants will be provided sharing accommodation at the institute, based on the availability, on payment basis.

Any communication or clarification can be made to **gianfeb14@gmail.com**

A GIAN course on

PHOTOCHROMIC MOLECULES AND MATERIALS FOR A SUSTAINABLE FUTURE

(Date: 14-18th February, 2018)

Department of CHEMISTRY
National Institute of Technology (NIT) Rourkela
Rourkela – 769 008, Odisha, India

REGISTRATION FORM

Name: _____

Qualification: _____

Designation: _____

Organization: _____

Mailing Address: _____

Phone No: _____ E-mail:_____

GIAN Reg. No: _____

Gender: Male/ Female

Accommodation Required: Yes/No

Registration Fee Details:

Demand Draft No: _____ Date: _____

Amount: _____ Issuing Bank: _____

Signature of Applicant with Date: _____

Signature of Course Coordinator with date

Course Details:

Total Duration: 19 hrs (13 Lectures, each of 4 hr , Tutorial Classes- 4 nos, each of 1 hr, Examination – 2hrs)

Duration of Course: 14th to 18th February 2018

Total Credits: 19

Modules	Date/ Day	Lecture / Time Credits	Title
Module- A	**14th February (Thursday)**	**3 Hrs (L-T : 3:0)**	**Basic Concepts on Photochromatic Molecules**
		Lecture 1: 11:00- 12:00	*Importance of Light in the 22nd Century*
		Lecture -2: 12:30- 13:30	*Molecular Function, Red-ox units, Tetrathiafulvalene (TTF) Building Blocks, Photo/Thermoswitches*
		Lecture-3: 16:00 – 17:00	*Molecular Systems-I - Stilbene, Linked Anthracenes* ***Tutorial Assignments to be given to students***
Module- B	**15th February (Friday)**	**4 Hrs (L-T : 3:1)**	**Organic Synthesis and Molecular Engineering of Photochromatic molecules**
		Tutorial-1 09:30- 10:30	**Problem Set-1**
		Lecture-4: 10:30 – 11:30	*Molecular Systems- II- Norbornadiene-Quadricyclane System, Fulvene-Diruthenium systems, etc*
		Lecture 5 : 11:30 – 12:30	*Classics in Photochemical Reactions, Photo-redox Catalysis and Organo-catalysis*
		Lecture 6: 15:00- 16:00	*Basic Engineering Challenges- Photochemistry, Energy storage, heat release, stability and availability* ***Tutorial Assignments to be given to students***
Module C	**16th February (Saturday)**	**4 Hrs (L-T : 3:1)**	**Applications of Photochromatic Molecules and Materials**
		Tutorial-2	**Problem Set-2**

		09:30- 10:30	
		Lecture-7: 10:30 – 11:30	*Case Studies: Azobenzenes, Fluorescent Probe for Carbohydrates, Logic gate*
		Lecture-8: 11:30 – 12:30	*Fluorophores, Light harvesters and Dyes, Combining Chromophores and Red-ox units in artificial Photosynthesis Device*
		Lecture 9: 15:00 – 16:00	*Organic wires, molecular rectifiers, organic molecular Switches* ***Tutorial Assignments to be given to students***
Module D	**17th February (Sunday)**	**4 Hrs** **Credits – (L-T : 3:1)**	**Future Challenges in Photochromatic Molecules and Materials**
		Tutorial-3 **09:30- 10:30**	**Problem Set-3**
		Lecture 10: 10:30- 11:30	*Energy Storage and Heat release, Stability tests*
		Lecture-11: 11:30- 12:30	*Fluorescence Imaging at the Nanoscale, Fluorescence with Photochromatic Compounds, Design of fluorophore-oxazine dyads*
		Lecture-12: 15:00- 16:00	*Design and Assembly of Photoswitchable Nanoparticles, Conclusions, Recapitulation and Outlook* ***Tutorial Assignments to be given to students***
Module E	**18th February (Monday)**	**4 Hrs** **Credits – (L-T-E : 1:1:2)**	**Organic Synthesis and Molecular Engineering of Photochromatic Molecules and Materials**
		Tutorial-4 **09:30- 10:30**	**Problem Set-4**
		Lecture 13: 10:30- 11:30	*Tactics and Concepts of Organic synthesis and its applicability to suitable design of Photochromatic molecules*
		Examination Schedule: 12:00 – 14:00	*Total Marks : 100*

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