GREENER STRATEGIES FOR ORGANICS AND NANOMATERIALS

(Sustainable applications of nano-catalysts in synthesis and environmental remediation)

Overview

Green and sustainable way of thinking and the implementation of such strategies are imperative for the survival of the planet. They are exceedingly vital and persuasive for the populated areas where the demand for resources and generation of greenhouse gases and pollution is detrimental to the quality of life. Green chemistry and engineering principles, the cornerstone for the development of sustainable chemical processes and products, when used in isolation do not provide optimal results. The planned lecture series addresses multitude of these aspects in all-inclusive cohesive approach which incorporates several such thematic principles *concurrently* in the overall strategy.

Organic reactions under solvent-free conditions are advantageous because of enhanced selectivity and efficiency, ease of manipulation, and more importantly, avoids the use of toxic and volatile solvents. Solvent-free approaches involve mechanochemical mixing (grinding), microwave (MW) irradiation of neat reactants (undiluted), or catalysis by the surfaces of inexpensive and recyclable mineral supports. The development of efficient and selective greener methods has become a major focus of researchers worldwide and selection of suitable alternate eco-friendly reaction media has become an integral part of this paradigm shift:- MW irradiation as an alternative energy source in conjunction with water as a reaction medium is one such successful ógreenerô chemical methodology.

The heavy investment in the development and deployment of products containing nanomaterials is now a worldwide phenomenon. The unique physical and chemical properties of nanomaterials are attractive for application in a variety of technology areas:- they are being widely used in varied applications from cosmetics to semiconductors. Nanotechnology development and especially the production of nanomaterials present unique opportunities to advance more sustainable tactics that protect public health and the environment. There is a great need for various monitoring agencies to provide manufacturers and users with the most up-to-date science on the potential risk of these materials on human health and the environment and robust information on how to prevent future environmental liability.

The approach embodied in this lecture series provides a scientifically based framework for greener preparation of these materials in a manner that renders the materials less mobile in the environment and reduces or eliminates the use and generation of hazardous substances, namely hydrazine and borohydride reducing agents normally used in nanomaterials production. The synthesis of nanometal/nanometal oxide/ nanostructured polymers and their stabilization (through dispersant or -biodegradable polymer) via the use of natural renewable resources such plant material extract, biodegradable polymers, and sugars, and the utility of MW irradiation as an efficient and selective mode of activation, will be described.

The long-term goal is to provide õguidelinesò for nanomaterial manufacturers to follow that reduces risk to human health and the environment and prevent future clean-up of these materials if they are found to be toxic. In the short term, discreption will also cover the use of other benign materials to help synthesize *nanometals/polymer nanostructures/nanopolymer composites* and to explore their catalytic properties for various chemical and environmental remediation applications. These may range from catalysts to destroy noxious and toxic gases as CO, SOx, and NOx in automobile catalytic converters and power generation systems from burning of gasoline and coal to highly sensitivity sensors**,** water purification, membrane systems, adsorption of heavy metals, and antibacterial coatings.

OBJECTIVES

The primary objectives of the course, applicable to broader class of organics and nanomaterials, are:

i) A comprehensive approach that encompasses eco-friendly chemical synthesis using benign conditions for organics, nanomaterials and nano-catalysts and focuses on *'greener' chemical synthesis*, *toxicology, biocompatibility and sustainable applications of ensuing nanomaterials*.

ii) Development of newer and safer chemical pathways using benign reagents and solvents that highlight the use of microwave-, solar-, or visible light-activation to reduce energy demand and exposure risk.

iii) To educate and train the future generations of scientists to think of environment and sustainability first before undertaking any chemical activity.

Module	**Greener strategies for the synthesis of organics and nanomaterials** **November 25-29, 2016** **November 25, 2016 (FRIDAY)** • Green Chemistry and its Principles including US Presidential Award winning Case Studies • Alternative Chemical Synthetic Pathways • Solvent-Free Processes Using Mechano-chemical Mixing or Supported Reagents **November 26, 2016 (SATURDAY)** • Alternate Energy input systems to accelerate Chemical Reactions • Expeditious Organic Syntheses via Activation by Microwave (MW) and Ultrasound Irradiation in Eco-friendly Media-Combinatorial chemistry • MW-Assisted Reactions in Water, Polyethylene Glycol (PEG) and Ionic Liquids-Synthesis of Heterocycles and C-C Bond forming reactions **November 27, 2016 (SUNDAY)** • Nanomaterials-Introduction and General Synthesis • Greener (Biomimetic) Syntheses of an Array of Nanomaterials • Reducing Environmental and Human Health Risk and Avoiding Future Environmental liability **November 28, 2016 (MONDAY)** • Safer Applications of Polymer Nanocomposites (Cellulose and Chitosan) for Chemical Catalysis • Magnetic Nanoparticles and their Sustainable Applications as Nano-catalysts • Nanomaterials in Environmental remediation (C-,S-,and N-doped Titania and Graphitic Carbon Nitrides as examples) **November 29, 2016 (TUESDAY)** • Final Interactive Examination **Number of participants for the course will be limited to fifty**
You should attend if…	• you are a research scientist in Chemistry interested in exploring the Greener strategies for organics and nanomaterials • you are chemist or biologist interested to learn emerging applications of nano-catalysts in synthesis and environmental remediation. • you are a student or faculty from academic institution interested in learning basics of green and sustainable way of thinking and the implementation of such strategies in research and industrial implementation.
Fees	The participation fees (Demand draft drawn in favour of Registrar, GJUS&T, Hisar) for taking the course is as follows: **Participants from abroad : US $500/-** **Indian Industry/ Research Organizations : Rs. 2000/-** **Indian Academic Institutions : Rs. 1000/-** The above fee includes all instructional materials, computer use for tutorials and assignments, equipment usage charges, and internet facility. However, the participants will be provided with accommodation on payment basis.

The Faculty

Dr. Rajender S. Varma (H-index 87) is senior scientist in Sustainable Technology Division, National Risk Management Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, USA and visiting scientist at Palacky University at Olomouc, Czech Republic. Earlier, he was Research Professor at Sam Houston State University, Project Manager at Texas Research Institute for Environmental Studies (TRIES), and Senior Scientist at Houston Advanced Research Center, The Woodlands, Texas, USA.

Given his varied accomplishments in research and significant contributions to the scientific community, the US EPA has honored Dr. Varma with several awards over the years including: an Office of Research and Development (ORD) Sustainability Award (2015), for "Sustainable Strategies for Risk Reduction In Nanotechnology: Application in Chemical Catalysis and Environmental Remediationò a Silver Medal for Superior Service-EPA for outstanding scientific and leadership contributions establishing EPA as a pioneering organization in the area of Green Chemistry (2013), several National Risk Management Research Laboratory Awards: A Systems Approach to Sustainable Solutions (2012), Environmental Solutions (2010), Visionary of the Year Award - Green Technology for the Environment (2009), in addition to numerous Science and Technology Achievement Awards. He has published more than 450 peer-reviewed research papers, 15 United States patents, 7 books, 27 book chapters and 3 encyclopedia contributions.

Dr. Devinder Kumar is Professor in the Department of Chemistry, Guru Jambheshwar University of Science and Technology, Hisar. He earned his M.Sc., M.Phil. and Ph.D (1991) in Organic Chemistry from Kurukshetra University, Kurukshetra. Prior to joining as Lecturer, he was Research Associate of Council and Scientific Research (CSIR). He did his post-doctorate research at College of Pharmacy, University of Texas at Austin, Austin, USA. He has published sixty research papers in the peer-reviewed journals in the field of organic synthetic chemistry, medicinal chemistry, reagent in organic synthesis, etc. He was conferred with Best Teacher Award by Chemical Research Society of India in 2011. Presently, he is also Director of Central Instrumentation Laboratory, GJUST, Hisar

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