MANGALORE UNIVERSITY
Centre for Application of Radioisotopes and Radiation Technology (CARRT)

GIAN Short Course on

Nanofibers and their applications

Overview

Fibres produced by electrospinning have been known for over ninety years, when Czech-American physicist John Zeleny studied techniques nowadays known as electrospinning and electrospraying. When a conductive liquid in a capillary is exposed to an electric field in a range of ~10 kV, the liquid shape forms a cone, which emits a jet of liquid. Fibres are formed by the solution drying during flight to the opposite electrode (collector). Industrial production based on roller electrospinning was developed by Oldrich Jirsak, professor of TUL, in the Czech Republic in 2004. Nowadays, sub-micron fibres and nanofibers can be formed from solutions and melts, from various chemicals and material mixtures, from traditional or "green" materials, in a DC or AC field, and with core-shell structure of two different materials, etc. Similar to the broad spectrum of fibre types, the potential for their application is even broader. This includes in mechanical engineering, optics, electronics, medicine and drug production, biotechnologies, environmental protection, e.g.

The course aims at understanding the fundamentals, synthesis, characterizations and properties of nanomaterials and mainly nanofibers, but also nanoparticles and their potential applications in different fields.

Objectives

The primary objectives of the course are as follows:

i. To introduce the participants to the fundamentals of nanomaterials
ii. To expose the participants to electro-spinning of nanofibers and their characterisation
iii. To provide detailed knowledge on the potential applications of nanofibers and other nanomaterials
iv. To examine and plan a collaborative research program on the synthesis and applications of nanofibers.

Course participants will learn these topics through lectures and hands-on demonstrations. In addition, case studies and assignments will be shared to stimulate the research motivation of the participants.

Dates	27th February to 7th March, 2017
No. of Credits	14 Lecture hours - one credit course
No. of Participants	About 50

Course Details

Day 1: Nanomaterials – Introduction (2 hours)

Overview of the course – History of nanomaterials – Definition of nanomaterials – One, two and three dimensional nanomaterials – Natural nanomaterials – Synthesis of nanomaterials: Top-down and bottom-up approaches – "green" synthesis of nanoparticles.

Day 2: Preparation and characterization of nanomaterials (2 hours)

General methods for nanomaterials preparation – Details of nanolayers, nanoparticles and other nanomaterial preparation – Properties of material dependent on preparation - Characterization of nanomaterials – Morphological characterization using SEM and TEM techniques – UV-Vis spectroscopy, X-Ray Techniques – Methods for particle size distribution, etc.

Day 3: Preparation of nanofibers (2 hours)

Synthesis of nanofibers – Electropsun fibers of natural polymers – Nanoparticles functionalized electrospun polymers – Physicochemical properties – Electrospinning techniques: System and process parameters – Selection of polymers (natural/synthetic) and solvents (aqueous/organic/inorganic).

Day 4: Nanofibers of natural polymers (2 hours)

Development of 'green' elecrospun fibers – Nanofibers based on biopolymers – Process of various blending mixtures– Parameters, characterizations, physicochemical properties – Structural enhancements of nanofibers using various plasma treatments – Functionalized nanofibers, key properties of nanofibers such as fiber diameter, porosity, surface area and mechanical properties etc.

Day 5: Potential applications of nanomaterials (2 hours)

Overview, various applications of different nanomaterials and composites – Nanolayers – Nanoparticles in drug delivery – Preparation of target nanomaterials and nanocomposites - Application of nanostructures for treatment of environmental liabilities – Cases study of remediation of chlorinated hydrocarbons - Case study of hexavalent chromium removal- Case study of oil refinery remediation – Case study of uranium liabilities.

Day 6: Potential applications of electrospun nanofibers (2 hours)

Overview of various applications – Specific application towards environmental and medical fields – Advantage of nanofibers compared to conventional fibers - Nanofibers and nanoparticles based membrane or nanocomposites – Adsorption/filtration, degradation – Toxic heavy metal treatment – Pesticides and organic compounds – Antibacterial properties – Nanoparticles immobilized on nanofibers – Natural polymer derivatized nanofibers for antibacterial applications – Development of nanofibers for fabricating scaffolds.

Day 7: Potential toxicity of nanomaterials (2 hours)

Concept of nanotoxicology – Methodology for nanotoxicology – Toxicity testing – Mechanism of nanosize toxicity – Reactive oxygen species mechanisms of NSP toxicity – Interactions between nanomaterials and environmental media – Fate of nanomaterials under various environmental conditions.

Day 8: Review and Examination

Who Should Attend

- Undergraduate, Post-graduate and Research Students of both Science and Engineering streams.
- Teachers, Scientists and Technologists from Academic and Research

Fee

The participation fees for taking the course are as follows:

1. Participants from abroad: **US $500**
2. Industry participants: **Rs. 10000**
3. Academic and Research Institutions:
   i. Postgraduate/Undergraduate students: **Rs. 500**
   ii. Research students: **Rs. 1000**
   iii. Faculty/Scientists: **Rs. 2000**

The above fees include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility.

Course Registration Fee

Rs. 500.00

Note: *Registration to the portal is one time affair and will be valid for lifetime of GIAN. Once registered in the portal, an applicant will be able to apply for any number of GIAN courses as and when necessary. One time Non-refundable fee of Rs. 500/- is to be charged for this service. Please also note that mere registration to the portal will not ensure participation in the courses. The course coordinator has the final say on the selection of participants. Please do not confuse with web registration with course registration. The course registration fee is separate. The candidate has to pay course registration fee as per directive from the course coordinator/host Institute to the local Institute only.*

Mode of Payment

DD in favour of the Course Coordinator, GIAN Short Course, CARRT, Mangalore University, Mangalagangotri – 574 199, Karnataka, India and payable at SBI, Mangalagangotri Branch.

Accommodation

Limited accommodation on request may be available in the University Guest House. Participants need to bear their own accommodation and food expenses.

Course Faculty

Professor Miroslav Černík

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Brief Curriculum Vitae: M. Černík received his Ph.D. in Natural Science at the Swiss Federal Institute of Technology (ETH Zurich) and thereafter started to work for the environmental consultancy firm AQUATEST a.s., in the Czech Republic. In 2007, he became an associated professor and in 2014 full professor at Technical University of Liberec (TUL). Nowadays, he is the Scientific Director of the Institute of Nanomaterials, Advanced Technologies and Innovations (CxI) of TUL and head of the department of Nanomaterials in natural science.

His main focus is a research of in situ remedial technologies, mainly the application of zero-valent iron nanoparticles for groundwater remediation and nanofiber application for wastewater treatment. Nowadays, he works on six international FP7 and H2020 research projects and a number of Czech national projects on application of nanomaterials for environmental protection, medical and other applications. In-situ application of zero-valent iron nanoparticles is related to remediation of groundwater polluted by chlorinated hydrocarbons like PCE, TCE, PCB, and inorganic pollutants like As, Cr, U, nitrates, etc. He is also interested in toxicity and the environmental impact of nanomaterials.

CxI institute has over 130 scientists and the department of Nanomaterials in natural science over 40. He is the author of four books on remediation (in Czech or English), over 75 scientific papers with more than 1500 citations.

Course Coordinator

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