



Government of India
Ministry of Human Resource
Development



A Global Initiative of Academic Networks (GIAN) course on **Microstructural Engineering and Properties of Advanced Ceramics** November 15-21, 2016

Overview

Owing to the unique combination of properties, advanced engineering ceramics are increasingly being used for a wide variety of applications ranging from refractory bricks to tiles for space shuttle, from bearings to radomes for missiles, from cutting tools to artificial hip joints, from catalyst supports to particle or gaseous filters and solar cells to packaging material for electronic components. For a given application, engineers involved in preparing components generally look for possible ceramic materials with required set of standard properties like density, hardness, strength, fracture toughness, thermal expansion coefficient, thermal or electrical conductivity etc. However, properties of the component are not controlled unless microstructural features like porosity, phase, grain size, defect distribution etc. are tailored for the given application. Therefore, a thorough understanding on the processing-microstructure-properties relationship of engineering ceramics is highly essential.

The major aim of the course is to understand the processing methods and the resulting microstructures of ceramics. The influence of microstructure on mechanical, thermal and electrical behavior of advanced ceramics will be systematically studied.

Course Objectives

The major objectives of the proposed course are as follows:

- (i) To realize the significance of ceramics for various applications
- (ii) To understand the processing methodology for preparing dense to porous ceramics
- (iii) To study microstructural and phase evolution of ceramics
- (iv) To explore the influence of microstructure on properties of ceramics
- (v) To learn mechanical, thermal and electrical behavior of ceramics
- (vi) To understand processing-microstructure relation for ceramics

Modules	Each section of the course will cover fundamentals as well as state-of-the art on advanced techniques in processing, characterization and property evaluation of ceramics. Participants will learn through lectures and tutorial classes. Emphasis will also be made to highlight the potential research aspects of advanced ceramics.
You should attend if...	<ul style="list-style-type: none"> • Executives, engineers and researchers from industry and research laboratories • Students at all levels (B.Tech./M.Sc./M.Tech./Ph.D.), faculty working in the areas of ceramics, metallurgy, materials engineering/science, mechanical engineering, production and industrial engineering, nanotechnology, chemistry, physics and other related disciplines.
Fees	<p>The participation fees for attending the course is as follows:</p> <p>Participants from abroad: US \$500</p> <p>Participants from Industry: INR 10000</p> <p>Participants from Research Organizations: INR 8000</p> <p>Faculty Members/Researchers/Technical Staff from Academic Institutions: INR 5000</p> <p>Student Participants: INR 2500</p> <p>The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr free internet facility. Fee does not include accommodation and food. On request basis, participants may be provided with accommodation on payment basis.</p>

The Faculty



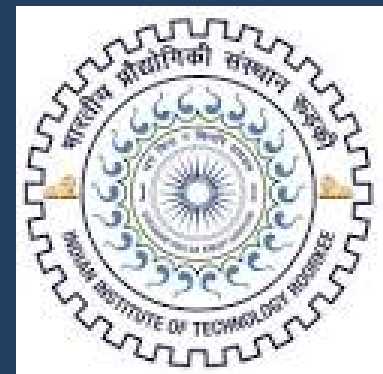
Prof. Young- Wook Kim is in the faculty of University of Seoul. His research has focused on the microstructure control and mechanical properties of dense and

porous SiC ceramics, the processing of polysiloxane-derived microcellular ceramics, and the processing of electrically conductive ceramics. He published more than 190 referred international journal papers and invented more than 40 patents. He received several awards for his outstanding research in ceramics. He is Editor-in-chief of the Korean Ceramic Society, Editor of the Journal of Asian Ceramic Societies and Editor of the Journal of Ceramics.



Dr. B. Venkata Manoj Kumar is currently Associate Professor at Department of Metallurgical and Materials Engineering, IIT, Roorkee and

involved in establishing triboceramics research. With the primary theme of understanding microstructure-property relations, Dr. Manoj has been actively involved in processing advanced ceramic systems like SiC, ZrB₂, TiCN-Ni cermets etc., and studying the influence of microstructural characteristics on their material removal mechanisms when subjected to different wear conditions.



Course Coordinator

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Lecture Plan
Microstructural engineering and properties of advanced ceramics
November 15-21, 2016

November 15, 2016 Tuesday

Inauguration: 2:00 pm to 2:30 pm

Inaugural Tea and Group Photograph: 2:30 pm to 3:00 pm

Lecture 1: 3:15 pm to 4:15 pm

Introduction to the course: advanced ceramics; processing, properties and applications

Tea: 4:15 pm to 4:30 pm

Lecture 2: 4:30 pm to 5:30 pm

Ceramic phase equilibria; important binary and ternary phase diagrams

November 16, 2016 Wednesday

Lecture 3: 9:30 am to 10:30 am

Processing I: Synthesis of ceramic powders; shape-forming processes

Tea: 10:30 am to 11:00 am

Lecture 4: 11:00 am to 12:00 noon

Processing II: Sintering fundamentals; grain growth

November 17, 2016 Thursday

Lecture 5: 9:30 am to 10:30 am

Microstructure: strategies for microstructure control, effect of sintering additives on microstructure

Tea: 10:30 am to 11:00 am

Lecture 6: 11:00 am to 12:00 noon

Grain boundary: effect of grain boundary on properties, strategies for engineering grain boundary of ceramics

November 18, 2016 Friday

Tutorial 1: 9:30 am to 10:30 am

Problem solving in ceramic processing, phase diagrams, microstructure, sintering, grain growth, and porosity

Tea: 10:30 am to 11:00 am

Lecture 7: 11:00 am to 12:00 noon

Porous ceramics: processing and properties of polymer derived porous ceramics

November 19, 2016 Saturday

Lecture 8: 9:30 am to 10:30 am

Mechanical properties of ceramics: factors affecting mechanical properties of advanced ceramics at room and high temperatures

Tea: 10:30 am to 11:00 am

Lecture 9: 11:00 am to 12:00 noon

Tribological properties of ceramics: factors affecting friction and wear of ceramics

Lecture 10: 3:00 pm to 4:00 pm

Wear mechanisms of ceramics

Tea: 4:00 pm to 4:15 pm

November 20, 2016 Sunday

Lecture 11: 9:30 am to 10:30 am

Electrical properties of ceramics: strategies for controlling electrical conductivity; conductive SiC ceramics

Tea: 10:30 am to 11:00 am

Lecture 12: 11:00 am to 12:00 noon

Thermal properties of ceramics: factors affecting thermal conductivity in advanced ceramics

Tutorial 2: 3:00 pm to 4:00 pm

Problem solving in porous ceramics, mechanical, tribological, electrical and thermal properties of ceramics

Tea: 4:00 pm to 4:15 pm

Lecture 13: 4:15 pm to 4:45 pm

Summary of the course

November 21, 2016 Monday

Examination for students: **9:00 am to 11:00 am**

Valedictory & Certificate distribution: **5:00 pm to 5:30 pm**