



# SURFACE ENGINEERING OF NANOMATERIALS

## PROF. KAUSHIK PAL

Department of Mechanical Engineering and  
Industrial Engineering  
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**INTENDED AUDIENCE :** Nano Science Nanotechnology, Chemical Engg, Chemistry, Aerospace Engg, Material Science and Mechanical Engg. etc.

**INDUSTRIES APPLICABLE TO :** Nanotech based industries: Nanoshel; Adnano Technologies; Mittal Enterprises; Ultrananotech; Reinste Nano Ventures; etc

## COURSE OUTLINE :

Surface engineering (SE) is a sub-discipline of Materials Science and Materials Engineering which deals with the surface of a solid and its modifications. The primary goal of SE of nanomaterials is to modify the properties of surface to improve its electrical and thermal properties, and to improve the compatibility of nanomaterials with some matrix when they are used as reinforcing fillers in composites for high performance applications.

## ABOUT INSTRUCTOR :

Prof. Kaushik Pal is an Associate Professor in Department of Mechanical and Industrial Engineering, IIT Roorkee since 2012. He has obtained his Ph.D Degree (2009) from IIT, Kharagpur and then joined to Gyeongsang National University, South Korea for pursuing Post-Doc research. His fields of interests are surface modification of nano-materials and use of such materials in different electronic, mechanical and bio-medical applications. Currently, he is acting as reviewer of several internationally known journals and an active member of National Academy of Sciences, American Chemical Society (ACS) and Royal Society of Chemistry (RSC). Also, he is the recipient of Brain Korea (BK-21) fellowship award and DAAD fellowship award.

## COURSE PLAN :

- Week 1:** Tribology & its classification, Friction tribology, Wear & corrosion, Lubrication, Effect of tribology on surface of nanomaterials
- Week 2:** Conventional surface engineering, Types of surface modifications, Physical modifications, Chemical modifications, Application of surface engineering towards nanomaterials
- Week 3:** Deposition and surface modification methods, Physical vapor deposition, Chemical vapor deposition, Advanced surface modification practices, Advantages of deposition for surface modification
- Week 4:** Synthesis, processing and characterization of nano-structured coatings, Functional coatings, Advanced coating practices, Characterization of nano-coatings, Applications of nano-coatings
- Week 5:** Need for advanced methods of surface and coating testing, Size dependency in nanostructures of nanocoatings, Size effect in electrochemical properties of nanostructured coatings, Size effect in mechanical properties of nanostructured coatings, Size effect in physical and other properties of nanostructured coatings
- Week 6:** Thin films for surface engineering of nanomaterials, Sputtering techniques, Evaporation processes, Thin film deposition through gas phase techniques, Liquid phase techniques
- Week 7:** Microencapsulation: Processes, Microencapsulation: Kinetics of release, Plating of Nanocomposite Coatings, Advantages of microencapsulation over other conventional methods
- Week 8:** Current trends in surface modification of nanomaterials, Modified Nanomaterials: In-use for consumer products, Main problems in synthesis of modified nanomaterials