UE Nanocomposites

ECTS
3 crédits

Composante
UFR Physique, Ingénierie, Terre, Environnement, Mécanique (PhITEM)

Période de l'année
Automne (sept. à dec./janv.)

Diplômes intégrant cet élément

- Master Nanosciences et nanotechnologies

Langue(s) d'enseignement: Anglais
Ouvert aux étudiants en échange: Oui
Code d'export Apogée: PAX9NCAD

Présentation

Description

This course will provide background on critical issues in synthesis, fabrication, processing, and characterization of material nanocomposites. We will discuss the underlying scientific principles that guide the study of structure-property relationships and will touch on parallel fields of investigation with high relevance to nanocomposites. The course will also cover the incorporation of a variety of nanophases into polymeric matrixes to provide functional materials, the importance of controlling surface energy, methods for achieving dispersion and common techniques for characterizing nanocomposite materials. The influence of the chemical nature of the dispersed (organic or mineral) elements on the different morphologies observed will be described. This lectures will discuss new concepts and knowledge within the field of electrochemical energy storage applications of nanocomposites.
The scope of this class is also to provide basic knowledge about graphene and to show how graphene based materials are being developed for a wide range of applications, notably in the field of energy storage. The basic of graphene structure and properties will be addressed along with the different graphene preparation methodologies. A focus will be made of graphene characterization. Considering that surface functionalization is a key tool to modulate graphene properties, various grafting methods will be presented. An important part of the course will be dedicated to the description of examples of how and why graphene is of interest for Li-

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ion batteries and supercapacitors applications. To widen the student appreciation of graphene use versatility, other examples of applications will be discussed such as fuel-cells, PV-related applications and others.

Heures d'enseignement

CM	CM	20h

Syllabus

The course consists of 10 lectures of 1.30 hrs.
• Introduction: Why nanocomposites?
• II. Macroscopic composites. Composites in the real world; Classification of composites; scale effects; the role of interfacial area and adhesion; three simple models for a-priori materials selection; the role of defects; Stress and strain; thermodynamics of deformation and Hooke's law; anisotropy and elastic constants; micromechanics models for elastic constants. Stress transfer; the model of Cox; the model of Kelly & Tyson.
• III. Polymer matrices used in nanocomposites: Thermosetting, thermoplastic, elastomers matrices, conducting polymers matrices.
• IV. Nanofillers : Fullerenes, carbon nanofibers, carbon nanotubes, metallic ; nanoparticules, montmorillonites organoclays
• V. Synthesis – processing : mixing with preformed particles, sol gel techniques, using nanobuidings blocks, nano-engineering of composite material
• VI. Properties and characterisation of polymer nanocomposites: mechanical, optical and electrical properties.
• VII. Applications of polymer nanocomposites: Organic solar cells, batteries and supercapacitors, flame retardant, gas barrier…
• VIII. Graphene nanocomposites and applications :
• Part I: Graphene. What is graphene. How is it prepared? How is it characterized ? Graphene or not Graphene?
• Part II: Graphene functionalization and graphene based nanocomposites; Why functionalizing graphene? Covalent functionalization. Non-covalent functionalization. Nanocomposites formation
• Part III: Graphene for energy storage/conversion applications. Graphene for which application and which graphene for which application? Processing graphene. Graphene or graphene composites for Li-ion battery applications. Graphene and derivatives for supercapacitor applications. Graphene and derivatives for fuel-cell applications. Graphene for photovoltaics related applications. Graphene for other applications

Période : Semestre 9

Infos pratiques

Lieu(x) ville

› Grenoble

Campus

› Grenoble - Domaine universitaire

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