

Program of course: “Advances in Nanotechnology: Synthesis, Characterization and Application of Nanomaterials”

Professor: Dra. Elena Baranova (University of Ottawa)

Course description: Introduction to nanotechnology; Atoms, clusters and nanomaterials; Preparation and synthesis: chemical, physical; Properties of nanomaterials: mechanical, chemical/catalytic, magnetic, optic electronic; Application: heterogeneous catalysis, electrocatalysis, optics, ceramics, medicine and pharmacy, electronics.

I. INTRODUCTION

II. SYNTHESIS AND PREPARATION

Nanoparticles
Nanowires
Nanotubes
Thin films
Composite systems: nanostructures
Magnetic particles. Specific synthesis methods

III. THE ROLE OF THE SURFACE

Electrical surface charge
Thermodynamic aspects. Wettability
Surface energy
Potential energy of interaction. Stability

IV. ELECTROMECHANICS AND MAGNETOMECHANICS OF PARTICLES

Fundamentals: dipoles and multipoles
Electro-and magneto-phoresis
Theory of chain formation
Interactions between dielectric or magnetic particles

V. APPLICATIONS

Balance between preparation difficulties and special performance
Applications in semiconductor technologies: sensors, FETs, photonics
Biomedical applications
The case of magnetic nanoparticles
Toxicological studies: risks associated to the use of nanomaterials
Catalysis, Fuel Cells and Energy Storage.

BIBLIOGRAPHY

1. Hosokawa M. Nanoparticle technology handbook. Elsevier, Amsterdam, 2016.
2. Energetic Nanomaterials Synthesis, Characterization, and Application
Edited by: Vladimir E Zarko and Alexander Gromov ISBN: 978-0-12-802710-3, 2016

3. Sugimoto T. Fine Particles: Synthesis, Characterization, and Mechanisms of Growth. Surfactant Science Series, Vol. 92. Marcel Dekker, New York, 2015.
4. Rahman M, Laurent S, Tawil N, Yahia L, Mahmoudi M. Protein nanoparticle Interactions: The Bio-Nano Interface. Springer, Berlín, 2013.
5. Handy RD, Shaw, BJ. Toxic effects of nanoparticles and nanomaterials: Implications for public health, risk assessment and the public perception of nanotechnology. Health, Risk & Society 9(2007)125.
6. Introduction to Graphene-Based Nanomaterials From Electronic Structure to Quantum Transport
Luis E. F. Foa Torres, Stephan Roche, Jean-Christophe Charlier, Cambridge University Press, 2014

RECOMMENDED LINKS

Nature Nanotechnology: www.nature.com/nnano/

Journal: <http://www.mdpi.com/journal/nanomaterials>

UK Institute of Nanotechnology: <http://www.nano.org.uk/>

Nanomaterials news: <http://phys.org/nanotech-news/nano-materials/>

US National Nanotechnology Initiative: <http://www.nano.gov/>

TEACHING ACTIVITIES

- Theoretical lessons
Computer simulations of complex systems behavior
- Seminars and presentations by students
- Academic tutorials

EVALUATION

Final written exam with a problem solving and assigned case.