Course title: Modern methods for the characterization of nanostructures

Academic teacher(s): Dramićanin D. Miroslav

Status: elective

ECTS: 15

Requirements:

Learning objectives

Training students to perform some of the basic experimental methods and procedures in the characterization of nanomaterials and nanostructures.

Learning outcomes

The acquisition of knowledge and skills in analyzing and interpreting the results obtained in the characterization of nanostructured materials with different methods, and independent performanse of the selected experiment of the characterization of nanostructures.

Syllabus

Theoretical instruction

Introduction to the basic principles of materials characterization. General classification methods of characterization. Diffraction, microscopic and spectroscopic characterization methods of nanostructures. X-ray diffraction. Scanning electron microscopy (SEM). Transmission electron microscopy (TEM). Scanning probe microscopy (SPM). Scanning tunneling microscopy (STM). Introduction to luminescence. Classification of the most significant luminescent methods (photo-, hemi-, electro-, tribo-, radio-luminescence). The luminescent phenomena in nanomaterials. X-ray Fluorescence (XRF)-qualitative and quantitative determination of the materials composition. Vibrational spectroscopy (Infrared, Raman). Magnetic spectroscopy (Nuclear magnetic resonance-NMR, electron paramagnetic resonance-EPR). Methods for the characterization of thin films and analysis of the results. Specificities in the interpretation of the experimental results in the characterization of nanomaterials and nanostructures.

Practical instruction

Research work and preparation and presentation of the seminar papers.

Литература

1. G. Schmid, *Nanoparticles: From Theory to Application*, Wiley, 2004.
2. R.W. Kelsall, I.W. Hamley, M. Geoghegan, *Nanoscale Science and Technology*, John Wiley & Sons, 2005.
3. G. Cao, *Nanostructures and nanomaterials*, Imperial College Press, London, 2005.
4. C.P. Poole, Jr., F.R. Owens, *Introduction to Nanotechnology*, Wiley-Interscience, 2003.
5. Z. Guo, L. Tan, *Fundamentals and Applications of Nanomaterials*, Artech House, 2009.
6. W.G. Moffatt, G.W. Pearsall, J. Wulff, *Strukture i osobine materijala, knjiga I: Strukture*, TMF, Beograd, 1975.
7. M. Kohler, W. Fritzsche, *Nanotechnology*, Wiley, 2007.
8. Y. Pathak, D. Thassu, Drug Delivery, *Nanoparticles, Formulation and Characterization*, Informa Healthcare, 2009.
9. G.P. Wiederrecht, *Handbook of Nanoscale Optics and Electronics*, Elsevier, 2010.
10. V.K. Varadan, L. Chen, J. Xie, *Nanomedicine*, Wiley, 2008.
11. H.E. Schaefer, *Nanoscience*, Springer, 2010.
12. V. Pecharsky, P. Zavalij, *Fundamentals of Powder Diffraction and Structural Characterization of Materials*, Springer Science and Business Media, Inc., New York, 2005.
13. R.C. Roop, *Luminescence and the Solid State*, Elsevier Science, 2004.
14. H.F. Ivey, *Electroluminescence and Related Effects*, Academic Press INC, 1963.
15. J. Keeler, *Understanding NMR Spectroscopy*, Wiley, 2004.
16.L.I. Maissel, R. Glang, *Handbook of Thin Film Technology*, McGrow-Hill, 1970.
17. J.W. Adamson, *Physical Chemistry of Surfaces*, Wiley, 1990.

Weekly number of teaching hours	Lectures: 4	Study Research: 6

Methods of teaching

Theoretical teaching is carried out using modern presentation methods, with the active participation of the student, and practical teaching involves the preparation and presentation of the seminar work.

Assessment of knowledge (maximum score 100 points)

Pre-exam obligations	Maximum points	**Final exam**	Maximum points
Activities during lectures/Consultations	5	Oral exam	70
Practical teaching	10		
Seminary work	15		