Novel Concepts for 3D Nanoengineering

8 - 26 April 2013

Objectives:
Educate and introduce (PhD,MSc,BCh) students to the newest established and emerging concepts and equipments related to fabrication of nanostructures by atomic layer deposition and focused charged particle beams (electrons and ions) and their in-situ characterisation.

Content:
- Context: Classical thin film deposition and lithography concepts for nanostructure fabrication: PVD, CVD, resist based lithography (UV, e-beam, nanoimprint, EUV), lift-off.
- Introduction to novel concepts: templated Atomic Layer Deposition & focused electron/ion beam assisted chemical vapour deposition.
- Introduction to Chemistry of ALD and CVD molecules; Surface and Electron triggered reactions: Fundamentals of Adsorption and Desorption, Vapour Pressure, Surface Diffusion, Dissociation.
- Introduction to Scanning Electron / Ion Microscopes: SEM, Ga-FIB, He-FIB, AuSi-FIB
- Electron / Ion interaction with solids: concepts and simulations
- Analysis with focused electron and ion beams: EDX, EBIC, EBSD, tomography
- Nanofabrication with FIB and FEB: milling, deposition, etching, lithography
- Novel Add-Ons for Nanomanipulation and Nanoanalysis inside electron microscopes: 4-point electrical measurements, positioning systems for nanostructures, magnetic bead detection, mechanical measurements: tensile, bending, and compressive loading of nanostructures, 3D topography with in-situ atomic force microscopy, chemical depth profiling by combined FIB-mass spectroscopy.

Required knowledge: Physics and Chemistry at high-school level, general concepts of NanoSciences and Fabrication.

The course is supplemented by 15h lab tutorials (May 2013), covering the following topics:
- Casino/SRIM – Monte Carlo simulations of electron/ion trajectories in solids,
- OOMMF - micromagnetic modeling,
- FEM simulations of selected physical properties of the nanostructures,

ECTS: 3(lecture+seminar) +2(egzam) +2(lab)

E-mail registration for the course: lgondek@agh.edu.pl