Erasmus Mundus Joint Master GREENANO

SYLLABUS

Semester 3

COURSE NAME:	**Advanced Processing of Materials**
HOSTING UNIVERSITY:	Jozef Stefan International Postgraduate School

SEMESTER:	**NUMBER OF ECTS:**	**PILLAR:**
3	10	2

DISTRIBUTION OF HOURS

Lectures	*Seminars*	*Lab work*	*Individual student work*
30	30	30	210

PROFESSOR:	Uroš Cvelbar
LEARNING AND TEACHING METHODS:	Interactive lectures, seminar, work in laboratory, consultations.
PREREQUISITES:	Completed second-cycle studies in natural sciences or engineering or completed second-cycle studies in other fields with proven knowledge of fundamentals in the field of this course (certificates, interview). Basic knowledge of Solid State Physics is also requested.
OBJECTIVES OF THE COURSE:	The objectives of this course are to introduce students with: - advanced processing of materials, which are based mostly on use of thermodynamically nonequilibrium states of gas called plasma processing. The major benefits of this processing are ecological advantages and modifications or synthesis of materials on atomic scale atom-by-atom. The most useful plasmas for industrial environment are low or atmospheric pressure processing plasmas. Within this course, students gain knowledge on principles of plasma-surface interactions and material processing, which leads to surface activation, selective etching, cold ashing, surface nanostructuring and synthesis of new materials. Students become familiar with plasma processes for degradation of toxic materials and decontamination of surfaces. The lectures include the case studies of technological solutions for industrial applications, which enable students' critical assessment of applicability of processing technologies for materials in practice. - plasma nanoscience and its applications. Students will learn the basic concepts of plasma nanoscience, modern processes for preparation of nanomaterials or nanostructuring of surfaces including nanofabrication processes like plasma etching for development of nanostructured patterns, direct growth of nanostructures on different interphases, depositions from vapour phase as well as other modifications enabled by plasma. The plasma-assisted processes and mechanisms that enable such surface preparations will be outlined and connected to the roles of plasma radicals. Students will develop the ability to solve independent research and development tasks in the field of plasma-assisted nanostructuring of surfaces and nanomaterials, which includes basic concepts, proper selection of processes for preparation of surfaces and growth of nanomaterials with plasma.

	This objective is related to competences: - mastering of methods and techniques of sensor technologies, - ability to carry out independent as well as team R&D work, - ability to use the knowledge in practice, - and partially also to the development of an integral way of thinking and the ability to communicate with experts from other disciplines and fields.
CONTENT OF THE COURSE:	- Basics of plasma nanoscience - Basic interactions on interphase plasma surface which enable creation of 1D, 2D or 3D nanostructures - Overview of processing plasmas - Low-pressure versus atmospheric pressure plasmas - Application of plasmas into industrial processes for material treatment - Plasma surface activation - Selective etching of materials - Nanostructuring surfaces - Plasma synthesis of (nano)materials - New methods and processes which enable nanofabrication based on plasma-assisted processes - Cold ashing - Degradation of toxic materials - Decontamination of surfaces - Depositions of nanomaterials - Current challenges on the field of plasma nanoscience - Case studies (Polymer composites and technologies for their treatments)
INTENDED LEARNING OUTCOMES:	Students successfully completing this course will: - learn the basic knowledge of plasma nanoscience; - understand the plasma properties and processes, which occur during plasma material processing; - select a suitable data method for synthesis or modification of nanomaterials; - select proper plasma and its parameters for processing, which will further improve material surface properties, enable synthesis of new materials or cause their decomposition; - select a proper advanced environmentally friendly technological procedures for material processing; - understand underlying physical and chemical mechanisms of these processes; - learn about the commercial perspectives of the implementation of these technological procedures into industrial environment; - track the state-of-the-art in research and development in the field of plasma nanoscience and connected nanofabrication technologies; - establish the ability to communicate in English in the field of materials and technologies for their treatment.
FORM OF ASSESSMENT:	Seminar work and defense of the seminar work where the student demonstrates the achievement of all learning outcomes with at least one specific case for each outcome.