Krakowska Interdyscyplinarna Szkoła Doktorska

Opis przedmiotu/ *course description*

Przedmiot/ *Course* **:**	Zaawansowane metody badania powierzchni i cienkich filmów
Moduł kształcenia/ *Training module***:**	Moduł specjalistyczny
Okres realizacji/ *Implementation period* **:**	II rok, semestr letni
Język wykładowy/ *Language***:**	język angielski/ English
Prowadzący/ *Lecturer***:**	dr hab. inż. Jerzy Jedliński, Prof. AGH
Wymiar godzin przedmiotu/*duration* **:**	30 godzin
Forma prowadzenia zajęć/ *Form of teaching* **:**	Wykład/ ćwiczenia/ seminaria/ e-learning (liczba godzin wykładu: 9, seminarium: 6, laboratorium: 15)
Opis przedmiotu/ *course content***:**	Module is divided into three parts: I. Ideal and real surfaces, II. Methods of surface and thin films investigation, and III. Selection of the experimental methods: rules and examples. Part I deals with the surface description in terms of variety of approaches, starting from general one, through thermodynamic, structural, molecular to mechanical. Moreover, surface dynamics and electrical properties of surfaces are discussed. The beginning of the Part II consists of description of the concept of selvedge and of the concept and the approach to surface and thin film analyses related to the required information which should be experimentally provided with emphasis on the physical basics of methods and their parameters. Subsequently, the techniques are successively discussed, which enable getting qualitative and/or quantitative insight into the surface and/or thin films features (composition, including distribution of elements, microstructure, crystallographic structure, electronic structure, distribution of atoms and molecules, ...). Part III deals with application of techniques showing the rules which help in choice of the appropriate methods and giving several examples of their using to characterize various groups of materials. Methods of surface and thin films analysis: description I. Ideal and real surfaces (in brief) 1. General description 2. Thermodynamics of surfaces 3. The structure of surfaces

	4. Molecular and mechanical description of surfaces 5. Surface dynamics 6. Electrical properties of surfaces II. Methods of surface investigation 7. Concept of selvedge 8. General description of the concept and approach 9. Interaction of the particles/radiation with matter: application to surface investigation 10. Parameters of surface methods 11. Electron spectroscopies: XPS (X-ray Photoelectron Spectroscopy), AES (Auger Electron Spectroscopy, SAM (Scanning Electron Microscopy) 12. Scattered Ion Mass Spectrometry of light ions: RBS (Rutherford Backscattering Spectrometry), ISS (Ion Scattered Spectrometry) 13. Ion-Beam Mass Spectrometry – emitted ions: SIMS (Secondary Ion Mass Spectrometry), SNMS (Sputtered Neutrals Mass Spectrometry) 14. Scanning Probe Microscopy (SPM): STM (Scanning Tunnelling Microscopy), AFM (Atomic Force Microscopy), other 15. SEM (Scanning Electron Microscopy) 16. TEM (Transmission Electron Microscopy) 17. Sample preparation methods to electron microscopy studies (FIB, ion-beam thinning, …) 18. Raman Spectroscopy and Surface Enhanced Raman Spectroscopy (SERS) 19. Glow Discharge Optical Emission Spectroscopy (GDOES) 20. Grazing Incidence X-Ray Methods III. Selection of the experimental methods: rules and examples (strategy and tactics) Seminar classes: Methods of surface and thin films analysis: applications Applications: examples of application of various methods to surface and thin film analysis and solving the problems Examples: 1. Characterization of Carbon Nanotubes and Other Related Structures 2. Characterization of Nanowires 3. Characterization of Graphene and Other Monolayer Structures 4. Surface Analysis of Polymers 5. Characterization of Catalysts 6. Characterization of Various Thin Films, Coatings and Coating-Substrate Systems Steel 7. Characterization of Thermally Grown Oxides
Efekty uczenia się wg 8PRK zgodnie z	EU1,EU2,EU3,EU8,EU13

Programem kształcenia KISD/ *learning outcomes at level 8 of the PRK according to the KISD Training Program***:**	
Forma weryfikacji efektów uczenia się/ *Method of verification of learning outcomes***:**	Zaliczenie
Wymagania wobec uczestników/ *Requirements for participants***:**	Fundamental knowledge concerning physics and chemistry of solids and of interaction