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| **Course code** |  |
| **Type and description** | EC – Elective Course |
| **ECTS credit** | 1 |
| **Course name** | Nanomaterials Testing Methods |
| **Course name in Polish** | Metody badań nanomateriałów |
| **Language of instruction** | English |
| **Course level** | 8 PRK |
| **Course coordinator** | dr hab. inż. Łukasz Kołodziejczyk |
| **Course instructors** | dr inż. Bartłomiej Januszewicz |
| **Delivery methods and course duration** | |  | **Lecture** | **Tutorials** | **Laboratory** | **Project** | **Seminar** | **Other** | **Total of teaching hours during semester** | | --- | --- | --- | --- | --- | --- | --- | --- | | Contact hours | 0 | 0 | 0 | 15 | 0 | 0 | 15 | | E-learning | No | No | No | No | No | No |  | | Assessment criteria (weightage) |  |  |  | 100% |  | 0,00 |  | |
| **Course objective** | The aim of the course is to enable students to acquire knowledge in the field of selected research methods used to characterize nanomaterials and related problems. |
| **Learning outcomes** | After completing the course PhD student will be able to:  1. Discuss and apply basic and selected advanced SPM techniques for the characterization of nanomaterials.  2. Use nanoindentation technique for measuring the mechanical and tribological properties.  3. Characterize thin films using X-ray diffraction methods and use XRD methods to determine stresses in thin films.  4. Define the conditions and prepare samples for measurements at the nanoscale.  W4, U4, K1 |
| **Assessment methods** | Outcomes 1-4 – presentation (with discussion)  The final grade for the course consists of 100% of the presentation grade. |
| **Prerequisites** | Basic knowledge of physics and chemistry. |
| **Course content with delivery methods** | Project covering topics in the field:  Basic SPM techniques. Conditions and sample preparation for SPM measurements. Force spectroscopy. Application of AFM for biological samples. Problems related to SPM imaging. Artifacts. SPM image processing and data analysis. Lift Mode techniques. Fundamentals of mechanical and tribological properties measurements of nanomaterials using depth-sensing techniques. Low angle X-ray diffraction. Stress measurements using XRD techniques. |
| **Basic reference materials** | Documents available on websites and scientific articles related to the course content. |
| **Other reference materials** | 1. P. Eaton and P. West, Atomic Force Microscopy, Oxford University Press, Oxford 2010  2. A.C. Fischer-Cripps, Nanoindentation 2ed, Springer, New York 2004  3. R.W. Kelsall, I.W. Hamley, M. Geoghegan, Nanotechnologie, WNP, Warszawa 2008  4. R. Howland, L. Benatar, STM/AFM mikroskopy ze skanującą sonda - elementy teorii i praktyki, Warszawa 2002  5. P.C. Braga and D. Ricci (Eds.), Atomic Force Microscopy - Biomedical Methods and Applications, Methods in Molecular Biology vol. 242, Humana Press, 2003  6. E.L. Fleicher (Ed.), Scanning Probe Microscopy in Materials Science, MRS Bulletin, vol. 29, no. 7, 2004  7. N. Yao and Z.L. Wang (Eds.), Handbook of Microscopy for Nanotechnology, Kluver Academic Publishers, 2005 |
| **Average student workload outside classroom** | 15h |
| **Comments** |  |
| **Last update** | May 2023 |