GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00039700		
Field of study	Materials Engineering, Materials Engineering, Materials Engineering		
Date of commencement of studies	February 2023	Academic year of realisation of subject	2023/2024
Education level	second-cycle studies	Subject group	Optional subject group Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	2	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Metrology and Optoelectronics -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Artur Zieliński	
	Teachers	dr hab. inż. Artur Zieliński	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	0.0	0.0	30
E-learning hours included: 0.0						

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	30	8.0	37.0	75

Subject objectives

Presentation of the vacuum methods of preparation of thin films and plasma surface modification processes and applications of thin films as well as practical acquaintance with thin-film technology in the laboratory processes.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_K01	The student has knowledge of the direction in which thin film technology and CVD and PVD processes develop.	[SK3] Assessment of ability to organize work
K7_W05	The student knows the CVD and PVD techniques as well as tools and materials for their use.	[SW3] Assessment of knowledge contained in written work and projects
K7_U04	The student is able to design the process of synthesis of thin-film samples and to develop the results of research on such structures.	[SU2] Assessment of ability to analyse information
K7_W04	The student is able to correlate the parameters of materials with each other and adjust their structures in order to obtain specific physical and mechanical properties.	[SW1] Assessment of factual knowledge
K7_U01	The student has the knowledge of where to find information on the parameters of deposition of thin-film structures and the design of CVD and PVD processes.	[SU4] Assessment of ability to use methods and tools

Subject contents	Methods of producing and measuring vacuum. Overview of the vacuum technology. The growth process of thin films: condensation, nucleation, growth. Monitoring of the layer growth. Basic parameters of thin films and methods of measurement: thickness, adhesion, defects, chemical structure and physical. Types of substrates and methods of their preparation for specific processes. Processes PVD (Physical Vapour Deposition) production of metallic and non-metallic layers. Evaporation conventional and electron beam evaporation, sputtering and reactive sputtering. CVD processes (called Chemical Vapor Deposition): pyrolysis and synthesis processes and plasma processes. Review of applications: anti-corrosion coating, thin film technology in engineering, optical coating, thin film technology in microelectronics and nanolayers. Lab program: Processes of "wet" preparation of substrates and ion cleaning of substrates. Production and measurement of vacuum. Starting the PVD process. Starting the process of depositing layers of metals. Measuring the thickness of the layers by interference spectroscopy. Preparation of the CVD processes of thin film layers on the example of the diamond. Parameterisation of the process of plasma enhanced CVD microwave. Spectroscopic measurements generated in the plasma CVD process.
Prerequisites and co-requisites	

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
lab report	50.0%	50.0%
lecture test	50.0%	50.0%

Recommended reading

Basic literature	A. Hałas, Technologia wysokiej próżni, PWN, Warszawa,1990. K.L Lesker, Vacuum Products,2007. J. R. Roth, Industrial Plasma Engineering, IOP, Bristol,1995. R. J. Shul, S.J. Peartson, Handbook of Advanced Plasma Processing Techniques, Springer, Berlin, 2000
Supplementary literature	-
eResources addresses	

Example issues/ example questions/ tasks being completed

1. Preparation of substrates and undercover equipment for the PVD process.
2. The process of PVD (thermal evaporation) deposition of thin Al layers from a wire evaporator.
3. Masking of structures.
4. The process of PVD (thermal evaporation) deposition of thin Ag and Cu layers on monocrystalline silicon and glass substrates.
5. Layer resistivity measurements.
6. The PVD (flash evaporation + thermal evaporation) deposition process of NiCr / Au thin films.
7. The process of deposition of diamond layers in PA CVD in microwave plasma. Microscopic observations of sample surfaces.

Work placement	Not applicable