GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Manufacturing of semiconductor components, PG_00069762		
Field of study	Wytwarzanie elementów półprzewodnikowych		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish polish
Semester of study	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Optoelectronics -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Robert Bogdanowicz	
	Teachers	prof. dr hab. inż. Robert Bogdanowicz dr hab. inż. Michał Sobaszek dr inż. Mateusz Ficek	

Lesson types

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

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=1938

Moodle ID: 1938 Wytwarzanie elementów półprzewodnikowych - 2025/2026 https://enauczanie.pg.edu.pl/2025/course/view.php?id=1938

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	0.0	0.0	30

Subject objectives

The course aims to provide students with comprehensive knowledge of semiconductor device fabrication. Students will learn the properties of fundamental semiconductor materials and technologies for crystal growth and wafer preparation. They will master the principles and applications of thin film deposition processes using PVD, CVD, and MBE methods, as well as doping and oxidation techniques. Students will acquire skills in designing technological process sequences for selected microelectronic and optoelectronic devices and analyzing the impact of process parameters on manufactured structure quality. Upon completion, they will be prepared for cleanroom work and collaboration in technological teams.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U02] can perform tasks related to the field of study as well as formulate and solve problems applying recent knowledge of physics and other areas of science	The student can design technological process sequences, solve problems related to fabrication parameter selection, and optimize deposition and doping processes using knowledge from solid-state physics and materials engineering.	[SU4] Ocena umiejętności korzystania z metod i narzędzi [SU2] Ocena umiejętności analizy informacji
[K7_W02] knows and understands, to an increased extent, selected laws of physics and physical phenomena, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences related to the field of study	The student understands physical phenomena in semiconductor fabrication processes (diffusion, implantation, epitaxy, oxidation) and relationships between process parameters and electrical/ structural properties of devices.	[SW1] Ocena wiedzy faktograficznej [SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym
[K7_U07] can apply advanced methods of process and function support, specific to the field of study	The student can use in-situ process monitoring methods (reflectometry, ellipsometry) and computer simulations to optimize fabrication parameters and control semiconductor structure quality.	[SU5] Ocena umiejętności zaprezentowania wyników realizacji zadania [SU1] Ocena realizacji zadania
[K7_W03] knows and understands, to an increased extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	The student understands the structure and operating principles of semiconductor fabrication systems (CVD reactors, PVD vacuum chambers, MBE systems) and relationships between equipment parameters and manufactured structure properties.	[SW1] Ocena wiedzy faktograficznej [SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym

Subject contents

Course content – lecture

- **Fundamentals** - Semiconductor materials (Si, GaAs, GaN, SiC) / Vacuum generation and measurement methods / Overview of technological equipment
- **Semiconductor wafers** - Czochralski and flow-zone methods / Si wafer preparation (cutting, polishing) / Wafer cleaning (RCA) / Types of substrates and their preparation
- **Etching** - Wet and dry etching (RIE, ICP) / Selectivity / Etching profiles
- **Thin film growth** - Condensation, nucleation, growth / Growth monitoring (reflectometry, ellipsometry, RHEED) / Layer parameters: thickness, adhesion, defects, structure
- **Oxidation and doping** - Thermal oxidation, Si/SiO interface / Thermal diffusion and ion implantation
- **PVD processes** - Evaporation (conventional, e-beam) / Ion sputtering / Reactive evaporation / Contacts and metallization
- **CVD processes and epitaxy** - Thermal CVD (pyrolysis, synthesis) / PECVD (plasma processes) / MOCVD / Molecular Beam Epitaxy (MBE)
- **Applications** - Microelectronics (CMOS) / Optoelectronics (LEDs, lasers) / Sensors / Solar cells

Course content – laboratory

- **Si wafer preparation and cleaning** - RCA cleaning process / Contact angle measurement / Surface cleanliness control
- **PVD metal layer deposition** - Vacuum evaporation of Al/Au / Thickness and sheet resistance measurement / Adhesion analysis
- **CVD dielectric layer deposition** - PECVD deposition of SiO/SiN / Refractive index measurement / Stress analysis in layers
- **Electrical measurements of structures** - Four-point probe resistivity measurement / I-V characteristics of junctions / Carrier concentration measurement (Hall effect)
- **Profilometry and surface characterization** - Layer thickness measurement by profilometer / Surface roughness analysis / Structure topography mapping

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Test	50.0%	50.0%
Report	50.0%	50.0%

Recommended reading	Basic literature	Campbell, Stephen. *The Science and Engineering of Microelectronic Fabrication*. 2nd ed. New York, NY: Oxford University Press, 2001. ISBN: 0195136055. Vossen, John, and Werner Kern, eds. *Thin Film Processes*. Burlington, MA: Academic Press, 1978. ISBN: 0127282505. Vossen, John, and Werner Kern. *Thin Film Processes*. Burlington, MA: Academic Press, 1991. ISBN: 0127282513. Mayer, James W., and Sylvanus S. Lau. *Electronic Materials Science: For Integrated Circuits in Si and GaAs*. New York, NY: Macmillan, 1990. ISBN: 0023781408. Pierret, Robert, and George W. Neudeck. *Modular Series on Solid State Devices*. Vol. 1-5. Upper Saddle River, NJ: Prentice Hall, 1987, 89, and 90. ISBN: 0201122979. Pierret, Robert. *Advanced Semiconductor Fundamentals*. Upper Saddle River, NJ: Prentice Hall, 2003. ISBN: 013061792X.
	Supplementary literature	n/a
	eResources addresses	
Example issues/ example questions/ tasks being completed	n/a	
Practical activites within the subject	Not applicable	

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