GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Manufacture of Materials and Equipment for Hydrogen Technologies, PG_00070194		
Field of study	Hydrogen Technologies and Electromobility		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	Optional subject group Specialty 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	1	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Functional Materials Engineering -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Sebastian Molin	
	Teachers	dr hab. inż. Sebastian Molin dr inż. Patryk Błaszczak	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	0.0	15.0	45

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	45	3.0	27.0	75

Subject objectives

The course introduces students to fabrication methods for materials and devices used in hydrogen technologies. Lectures cover ceramic synthesis and forming techniques, thin-film methods, metal and polymer processing, and fabrication of key components of fuel cells, electrolyzers and hydrogen storage systems. Recycling and life cycle analysis are also addressed. In the seminar, students present and critically analyze selected scientific publications on the discussed fabrication methods.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_W11] knows and understands, to an increased extent, the general principles of creation and development of forms of individual entrepreneurship and the economic, legal and other conditions of various types of activities related to the awarded qualification, including the principles of protection of industrial property and copyright law	The student knows the economic and environmental conditions of manufacturing processes for hydrogen technology components, including the principles of life cycle assessment (LCA), techno-economic analysis (TEA) and design for circularity.	[SW2] Assessment of knowledge contained in presentation
	[K7_U09] can carry out a critical analysis of the functioning of existing technical solutions and assess these solutions, as well as apply experience related to the maintenance of advanced technical systems, devices and facilities typical for the field of hydrogen technologies and electromobility, gained in the professional engineering environment	The student can critically analyze and evaluate existing technical solutions for the fabrication of fuel cell, electrolyzer and hydrogen storage components, identifying their limitations and possibilities for manufacturing process optimization.	[SU2] Assessment of ability to analyse information
	[K7_U10] can individually plan and pursuit their own lifelong education and influence others in this aspect, also by means of advanced information and communication technologies (ICT), and communicate on specialist issues with diverse recipients, appropriately justify points of view, hold debates, present, assess and discuss different opinions and points of view, as well as use specialist terminology related to the field of hydrogen technologies and electromobility in communication	The student can independently search for, analyze and present scientific publications on fabrication methods for hydrogen technology materials, formulate and justify positions, and conduct discussions using specialized terminology.	[SU4] Assessment of ability to use methods and tools
	[K7_W08] knows and understands, to an increased extent, the fundamental dilemmas of modern civilisation, the main development trends of scientific disciplines relevant to the hydrogen technologies and electromobility	The student has an in-depth knowledge and understanding of modern fabrication methods for ceramic, metallic and polymeric materials used in hydrogen technologies, including current development trends in thin-film techniques, 3D printing and non-conventional sintering.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

- Methods of ceramic material fabrication (SOC I): top-down methods (milling, laser ablation, stripping) and bottom-up methods (sol-gel, precipitation, pyrolysis, hydrothermal methods).
- Ceramic forming methods (SOC II): rheology, electrokinetics and the electrical double layer in suspensions, granulation, forming techniques (tape casting, slip casting, extrusion), drying and sintering, diffusion phenomena and Fick's laws, post-processing (grinding, annealing).
- Specialized processing technologies for ceramics and metals (SOC III): thin-film methods (PLD, ALD, pyrolysis, CVD, PVD), plasma methods and spraying, infiltration, exsolution phenomena in ceramic layers, laser and flash sintering.
- Introduction to metal and polymer processing: metal forming and machining methods, metal surface treatment, polymer forming and processing methods (including 3D printing), polymer surface treatment.
- Fabrication of SOC structural components: 3D printing of steels and ceramics, interconnects, metal-supported SOC (MS-SOC), glass and ceramic sealants.
- Ion-exchange membranes and gas separation membranes.
- PEM cells polymer electrolyte membrane fuel cells and electrolyzers.
- AEM cells anion exchange membrane fuel cells and electrolyzers.
- Alkaline electrolyzers (I): separator, electrodes, bipolar plates.
- Alkaline electrolyzers (II): sealing, installation and system integration.
- Hydrogen sensors operating principles, materials and design.
- Balance of Plant (BoP) components: heat exchangers, water treatment systems.
- Hydrogen storage tanks and high-pressure components.
- Recycling, life cycle assessment (LCA), techno-economic analysis (TEA), design for circularity.
- Summary review of key topics, final discussion.

Course content – seminar

Students prepare and deliver presentations based on selected scientific publications on fabrication methods for materials and devices used in hydrogen technologies. Presentation topics include, among others: synthesis and forming of oxide ceramics, thin-film techniques, fabrication of ion-exchange membranes, forming of fuel cell and electrolyzer components, 3D printing of ceramic and metallic materials, and component recycling. Each presentation is followed by a discussion on the methodology used, obtained results and application potential.

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
assessment of presentation	60.0%	100.0%

Recommended reading

Basic literature	• M.N. Rahaman, Ceramic Processing, CRC Press/Taylor & Francis, Boca Raton, 2nd Edition, 2017. • S.C. Singhal, K. Kendall (Eds.), High-Temperature Solid Oxide Fuel Cells: Fundamentals, Design and Applications, Elsevier, Oxford, 2003.
Supplementary literature	• N.Q. Minh, T. Takahashi, Science and Technology of Ceramic Fuel Cells, Elsevier, Amsterdam, 1995. • W.D. Callister, D.G. Rethwisch, Materials Science and Engineering: An Introduction, Wiley, 10th Edition, 2018.
eResources addresses	

Example issues/ example questions/ tasks being completed

Practical activites within the subject

Not applicable

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