GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Supramolecular chemistry, PG_00066100		
Field of study	Chemistry		
Date of commencement of studies	February 2027	Academic year of realisation of subject	2027/2028
Education level	second-cycle studies	Subject group	Specialty subject group
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	exam
Conducting unit	Department of Chemistry and Technology of Functional Materials -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Ewa Wagner-Wysiecka	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	15.0	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	5.0	25.0	75

Subject objectives

To gain knowledge of the principles of supramolecular chemistry and their application in the design, preparation and characterization of functional materials. To understand the relationships between molecular structure, supramolecular interactions and material properties. To develop skills in experimental work, interpretation of research results, and critical analysis and presentation of scientific publications.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U03] plans and performs the synthesis of chemical compounds with the required properties	Plans and carries out the synthesis of selected supramolecular systems, choosing components and preparation conditions suitable for obtaining materials with specified properties.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
[K7_U04] develops and transmits technical information in the form of text documents, spreadsheets, graphs, technological diagrams and multimedia presentations, and prepares a speech including a multimedia presentation	Prepares and presents the results of investigations of supramolecular systems in reports, tables and graphs, and prepares and delivers an oral presentation supported by multimedia on supramolecular materials, using appropriate chemical terminology.	[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task
[K7_W01] recognizes problems of modern chemistry, including properties and obtaining chemical compounds, necessary for making calculations, including the dependence of the compound's structure and its reactivity	Has the knowledge necessary to explain the relationships between molecular receptor structure, the types of supramolecular interactions, and the stability and selectivity, and describes their significance in the preparation of materials and the control of their properties.	[SW1] Assessment of factual knowledge
[K7_W04] indicates methods for the synthesis of chemical compounds with defined properties	Has the knowledge to identify strategies for the synthesis of molecular receptors and preparing supramolecular materials with specified properties, considering, among others, the template effect, preorganization, the high-dilution method and self-assembly.	[SW1] Assessment of factual knowledge

Subject contents	Course content – lecture Basic concepts of supramolecular chemistry: ligand, receptor, host, guest, supramolecular complex. Types of non-covalent interactions and their role in determining the structure and properties of materials. Molecular recognition, complementarity and preorganization. Chelate, macrocyclic and macrobicyclic effects. Selected classes of molecular receptors, including podands, coronands, cryptands, calixarenes and cyclodextrins. Relationships between receptor structure and the stability and selectivity of complexes with cations, anions and neutral molecules. Strategies for the synthesis of macrocyclic compounds and methods for investigating host–guest interactions. Self-assembly as a method for creating ordered structures and functional materials. Selected materials based on supramolecular interactions: inclusion systems, metal–organic frameworks (MOFs), supramolecular polymers and gels. Relationships between the structure, spatial organization and properties of materials. Stimuli-responsive materials, molecular switches and molecular machines. Selected applications of supramolecular systems. Course content – laboratory 1. Preparation of porous materials with metal–organic framework (MOF) structures using the KOH/γ-cyclodextrin system as an example. Investigation of sorption properties. 2. Synthesis of urea and thiourea clathrates. Investigation of the physicochemical properties of the resulting materials. 3. Supramolecular complexes of organic compounds with cyclodextrins. Preparation and characterization of inclusion systems. 4. Chromogenic ion receptors in analytical applications. Investigation of complexation properties and selectivity using UV–Vis spectroscopy. 5. Preparation of supramolecular gels. Investigation of the properties of gel materials and their response to selected stimuli. Course content – seminar Current trends in supramolecular chemistry for the design of functional materials. Analysis of selected scientific publications on stimuli-responsive materials, self-healing systems, porous materials, molecular switches and molecular machines. Student presentations and discussions on the relationships between structure, supramolecular interactions, and the properties and applications of materials. Critical evaluation of proposed solutions, their potential and limitations. Presentation topics agreed upon with the instructor, taking students' interests into account.
Prerequisites and co-requisites	Knowledge and skills in organic, inorganic and physical chemistry, as well as the fundamentals of spectroscopic methods, at the undergraduate level. Ability to perform basic laboratory procedures in accordance with safety rules and to use scientific literature, including sources in English.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture - written exam	51.0%	40.0%
Seminar: preparation and delivery of a presentation and active participation in discussions; achievement of at least 51% of the total points available for these activities.	51.0%	30.0%
Laboratory: completion of all laboratory experiments and achievement of at least 51% of the points available for each test and each laboratory report.	51.0%	30.0%

Recommended reading

Basic literature	1. Kubik S., *Supramolecular Chemistry: From Concepts to Applications*, De Gruyter, Berlin–Boston, 2024. 2. Steed J. W., Atwood J. L., *Supramolecular Chemistry*, wyd. 3, Wiley, Hoboken, 2022. 3. Ariga K., Kunitake T., *Supramolecular Chemistry – Fundamentals and Applications: Advanced Textbook*, Springer, Berlin–Heidelberg, 2006. 4. Lecture materials and laboratory instructions provided by the instructors on the eNauczanie platform.
Supplementary literature	1. Dodziuk H., *Wstęp do chemii supramolekularnej*, Wydawnictwa Uniwersytetu Warszawskiego, Warszawa, 2008. 2. Aboudzadeh M. A., Frontera A. (red.), *Supramolecular Assemblies Based on Electrostatic Interactions*, Springer, Cham, 2022. 3. Champness N. R. (red.), *Supramolecular Chemistry on Surfaces: 2D Networks and 2D Structures*, Wiley-VCH, Weinheim, 2022. 4. Jiao T. (red.), *Supramolecular Gels: Materials and Emerging Applications*, Wiley-VCH, Weinheim, 2021. 5. Selected recent scientific articles on supramolecular chemistry and materials recommended by the lecturer.
eResources addresses	

Example issues/ example questions/ tasks being completed

1. Discuss the types of supramolecular interactions and their influence on the structure and properties of materials.
2. Explain the relationship between the structure of a molecular receptor and the stability and selectivity of the complexes it forms.
3. Compare strategies for the synthesis of macrocyclic compounds, considering the template effect, preorganization and the high-dilution method.
4. Using a selected example, discuss the role of self-assembly in the preparation of a functional material and the relationship between its structure and properties.
5. Propose a method for investigating the properties of a selected supramolecular system and interpret the results obtained.
6. Prepare a presentation based on recent literature on a selected supramolecular material, covering its preparation, properties, and the potential and limitations of its applications.

Practical activites within the subject	Not applicable

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