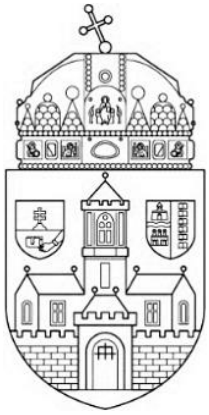

ÓBUDA UNIVERSITY
DOCTORAL SCHOOL ON MATERIALS SCIENCE AND TECHNOLOGY

CURRICULUM

Amended
based on the decision of the Doctoral School Council
March 2026
Accepted by OE EDHT on 27.03.2026

TABLE OF CONTENTS

1. THE AIM OF THE PROGRAM

The goal of the Doctoral School of Materials Science and Technology (ATDI) is to train professionals who possess comprehensive, coherent knowledge across a broad range of materials science, specialize in a field corresponding to their research, and are able to perform creative work based on independent thinking in the field of materials science and its practical applications. The Doctoral School strives to ensure that graduates are capable of leading research and projects, developing new research proposals, conducting their work on a solid foundation of research ethics, and thus becoming qualified to succeed in both higher education/research and other sectors of the labor market.

Areas of Training and Research: The doctoral school's range of subjects and topics—reflecting the complex nature of materials science—covers several subfields. This enables students to acquire coherent knowledge across the diverse fields of materials science during their training and research.
The doctoral program's curriculum includes foundational courses providing general knowledge of materials science and materials testing, as well as courses covering specific relevant subfields such as polymers, ceramics, metals, composites, micro- and nanostructured materials, and environmental protection. Students must select and complete a total of eight courses from the foundational and specialized courses during the first four semesters, under the guidance of their thesis advisor, in accordance with their research topic. Research topics can also be categorized according to the above grouping. Due to the complexity of materials science, both the courses and the topics span more than one of the above subfields.

Faculty and Advisors of the Doctoral School
The doctoral school's education and research are conducted by faculty and researchers at Óbuda University, as well as by institutions with contractual ties to the doctoral school (HUN-REN Hungarian Research Network Energy Research Center, Wigner Research Centre for Physics, Research Centre for Natural Sciences, as well as János Neumann University, University of Dunaújváros, Károly Eszterházy Catholic University, and Bay Zoltán Applied Research Public Benefit Ltd.) who are invited to collaborate. The faculty also includes several instructors from the Budapest University of Technology and Economics, the University of Debrecen, Eötvös Loránd University, Semmelweis University, and the University of Sopron.

2. FOUNDATIONAL KNOWLEDGE FOR THE DOCTORAL SCHOOL: (master's programs)

Due to the complex nature of materials science, the doctoral school is open to all master's degree holders who have acquired in-depth, master's-level knowledge of materials in a technical or natural science field during their previous studies.

Typical qualifying prior studies for the program include master's degrees in light industry engineering, materials engineering, wood engineering, chemical engineering, mechanical engineering, plastics and fiber technology engineering, bioengineering, electrical engineering, environmental engineering, materials science, chemistry, and physics.

The 2023 amendment to the Nftv. allows for the concurrent completion of master's and doctoral programs. The details and conditions of this are set forth in Section 12(2) of the EDHSZ.

3. DOCTORAL PROGRAM STRUCTURE

3.1. Structure of the Program

We offer general and specialized knowledge of materials science, organized according to the established subfields of the discipline. Some courses appear in multiple sections because, given the interdisciplinary nature of materials science, they span several subfields. In addition to specialized courses, courses in research methodology are also offered.

3.2. Structure of the Doctoral School's Educational Program

The doctoral program consists of 8 semesters. During these 8 semesters, students must earn 240 credit points to obtain their absolutorium, as follows:

- Courses: at least ***48 credits***, with each course worth ***6 credits***. A maximum of 10 courses (60 credits) may be counted toward the degree.
- Research project: ***10 credits/semester*** (***total*** over 8 semesters***: max. 80 credits***)
- Semesterly (written and oral) research reports (***total*** over 8 semesters***: 64 credits***):
  - ***Semesters 1–4: 6 credits***,
  - ***Semesters 5–8: 10 credits***

- Publications related to the research topic: ***at least 75 credits*** according to the evaluation criteria set forth in Appendix 5 of the EDHSZ D2 and ATDSZ]
- Participation in coursework: ***up to 60 credits*** (no mandatory minimum), 1 contact hour per week (1x45 minutes) = 2 credits.

As part of the program, students must enroll in and successfully complete a minimum of 8 courses (4 core and 4 elective).

Core courses: 4 courses are mandatory electives, which must be selected from the core course offerings (1.1 General Materials Science, 1.2 Materials Testing Methods, 1.3 Research Methodology).
Elective courses: Students may select 4 courses—with the supervisor's approval—from all courses offered by the doctoral school (both foundational and specialized). In accordance with relevant regulations, the academic requirement may also be fulfilled by completing a course taken at another doctoral school.

The table below shows the course enrollment structure and the schedule for required reports:

Sample curriculum, course structure

	Semester							
	1.	2	3	4.	5.	6.	7.	8.
Foundation Course 1	X							
Prerequisite Course 2	X							
Prerequisite Course 3		X						
Foundation Course 4		X						
Elective Course 1			X					
Elective Course 2			X					
Elective Course 3				X				
Elective Course 4				X				
Research Project	X	X	X	X	X	X	X	X
Research Report	X	X	X	X	X	X	X	X

3.3 Courses Offered by the Doctoral School

The following list contains the courses announced so far by the Doctoral School. At the beginning of each semester—depending on the number of interested students and the availability of instructors—a decision is made regarding the

launch of individual non-archived courses . Descriptions of the courses that can be announced can be found on the Doctoral School's Hungarian[1] and English[2] websites.

1. Foundation Courses

1.1 General Materials Science

1.1.1 Physical chemistry of surfaces
1.1.2 Porous Materials
1.1.3 Nanotechnology - Chemical Materials Science
1.1.4 Solid-state chemistry
1.1.5 Introduction to plasma chemistry
1.1.6 Fracture mechanics
1.1.7 Analysis of damage mechanisms in structural materials
1.1.8 Process design
1.1.9 Finite element modeling of materials technologies
1.1.10 Fundamentals of Engineering Ceramics
1.1.11 Biomaterials for Medical Applications
1.1.12 The Impact of Industry 4.0 on Manufacturing Technology
1.1.13 Materials for nuclear power plants
1.1.14 The Fundamentals of Materials Science

1.2 Materials testing methods

1.2.1 Selected Chapters on Materials Testing Methods I.
1.2.2 Selected chapters on materials testing methods II.
1.2.3 Modern separation methods in materials research
1.2.4 Fluorescence spectroscopy and microscopy
1.2.6 Investigation of surface microgeometry and microtopography
1.2.7 Fracture mechanics
1.2.8 Analysis of damage processes in structural materials
1.2.9 Finite element modeling of materials technologies
1.2.10 Measurement of Bioelectrical Activity
1.2.11 Optical characterization of thin films
1.2.12 Structural analysis of various materials using transmission electron microscopy
1.2.13 Numerical methods for evaluating optical measurements
1.2.14 State-of-the-art surface analysis techniques
1.2.15 Application of thermal and fluid dynamics modeling and numerical simulation in materials technology
1.2.16 Physical testing of textile clothing materials

1.3 Research methodology

1.3.1 Experiment Design and Evaluation
1.3.2 Statistical Hypothesis Testing
1.3.3 Engineering Education

[1] ATDI Objects.pdf
[2] ATDI items_en.pdf

1.3.4 Writing and Publishing Scientific Papers

2. Elective courses in materials science

2.1 Polymers

2.1.1 Chemistry and Physics of Polymers
2.1.2 Physics of Macromolecules
2.1.3 Characterization and Modification of Polymer Surfaces
2.1.4 Cellulose chemistry
2.1.5 Paper industry fibers and their surface properties
2.1.6 Cellulose and paper manufacturing
2.1.7 Mechanical and physical properties of papers and corrugated products
2.1.8 Synthetic fibers and technical textiles
2.1.9 Characteristics of antimicrobial light industrial raw materials
2.1.10 Biomaterials for medical applications
2.1.11 Testing of plastics and plastic-based composites
2.1.12 Structure of polymers
2.1.13 Engineering polymers

2.2 Ceramics

2.2.1 Technology of engineering ceramics
2.2.2 Material Structure and Fracture Mechanism of Technical Ceramics
2.2.3 Mechanical Properties of Technical Ceramics
2.2.4 Knowledge of powder technology
2.2.5 Biomaterials for Medical Applications
2.2.6 Technical ceramics

2.3 Metals

2.3.1 Phenomena Related to Continuous Casting of Steel
2.3.2 Modeling of thermally activated transformation processes in alloys
2.3.3 Materials technologies involving concentrated energy input
2.3.4 Welding Technologies I: Bulk Welding
2.3.5 Welding Technologies II: Pressure Welding
2.3.6 Knowledge of welding technology
2.3.7 Fundamentals of Plasticity
2.3.8 Non-classical problems in plasticity and creep
2.3.9 Theory of Machining
2.3.10 Titanium and titanium alloys
2.3.11 Materials for Nuclear Power Plants
2.3.12 Electrochemical metal extraction

2.4 Composites

2.4.1 Composites
2.4.2 Polymer-based nanocomposites
2.4.3 Biomaterials for Medical Applications
2.4.4 Finite element analysis of structures built from composite materials

2.5 Micro- and nanostructured systems

2.5.1 Semiconductor technologies
2.5.2 Semiconductor devices

2.5.3 Archive Solid-state light sources and their applications
2.5.4 Band Gap Engineering
2.5.5 Self-organizing low-dimensional systems
2.5.6 Nanotechnology - Chemical Materials Science
2.5.7 Medical applications of colloidal systems
2.5.8 Characterization and modification of polymer surfaces
2.5.9 Molecular beam epitaxy of III-V semiconductors
2.5.10 Optical characterization of thin films
2.5.11 Measurement of bioelectric activities
2.6 Environmental aspects of materials science technologies
2.6.1 Environmental Chemistry
2.6.2 Recycling of plastic waste by pyrolysis
2.6.3 Wastewater treatment technologies
2.6.4 Fundamentals of hydrology
2.6.5 Hydrobiology
2.6.6 Life Cycle Analysis
2.6.7 Environmental Product Declaration
2.6.8 The Environmental Impact of the Electronics Industry

3.4 Materials Science Seminar

Lectures on various fields of the diverse discipline of materials science, delivered by renowned guest speakers, are designed to help students conducting research in a specific subject area and taking courses related to that topic gain insight into the broadest possible range of materials science, and to acquire *a coherent understanding of materials science* to the extent possible. The materials science seminar is worth 3 credits, and attendance is verified by the lecturer's signature.

4. RESEARCH AND INTERNATIONAL RELATIONS OF THE DOCTORAL SCHOOL

4.1 Research Topics

The lists in the following chapters contain the research topics announced since the founding of the doctoral school, grouped by subject area. Some topics appear in multiple sections because, due to the coherence of materials science research, they span several subfields. Descriptions of the research topics can be found on the website of the National Doctoral Council (ODT) at[3] (broken down by year at ,

[3] https://doktori.hu/index.php?menuid=116&lang=HU

or in aggregate). By selecting the “current” field on the website, you can view the list of doctoral research topics announced for the given semester.

Research topic areas:

a) Polymers
b) Ceramics
c) Metals
d) Composites
e) Micro- and nanosystems
f) Environmental protection

a) Polymers

A significant portion of research in polymer chemistry and technology focuses on the processing of various sources of cellulose—the most abundant renewable raw material in nature—the development of new functions, and the recovery of cellulose-based raw materials. Engineering and innovative plastics are represented by topics where research allows for the acquisition of generally applicable testing methods and the development of polymers with intelligent behavior and environmentally beneficial properties.

1. Investigation of the Properties of Eco-Fibers *(János Dusza)*
2. The role of by-products in the formation of colored wood defects *(Levente Albert)*
3. UV laser-induced degradation of wood *(György Papp)*
4. Application of Transverse Sound Waves in the Examination of Wood and Wood Materials *(Ferenc Divós)*
5. Introduction of new cellulose-based chiral stationary phases *(Zoltán Juvancz)*
6. The role of component characteristics and manufacturing parameters in the recyclability of various paper products *(László Koltai)*
7. Production and potential applications of natural-based hydrogels *(Tünde Tóth)*
8. The effect of cellulose fibers of different origins and types on the properties of papers treated with PVOH/PVAc copolymers and their modifications *(László Koltai)*
9. Thermal identification of base papers for corrugated products as a function of the mechanical load-bearing capacity of the corrugated product *(László Koltai, Péter Böröcz)*
10. Activation and functionalization of polymer surfaces with non-equilibrium plasmas *(Szilvia Klébert)*
11. Atmospheric pressure photoionization mass spectrometry of nonpolar polymers *(Sándor Kéki)*
12. Relaxation processes in engineering plastics *(Károly Belina)*
13. Preparation and investigation of nanocomposites with polymer matrix *(Andrea Ádámné Major)*
14. Study of polymer-ceramic-metal composite systems *(Károly Belina)*
15. From macromolecules with branched topology to smart polymers *(Béla Iván)*
16. Environmentally beneficial chemical transformations and degradation of polymers and plastics *(Béla Iván)*
17. Development of biodegradable drug carriers *(Éva Kiss)*

18. Strain-optical investigation of polymer-containing hybrid composite structures processed using laser beam technologies *(Lajos Borbás)*
19. Research on polymer-based biosensors *(Gergely Márton)*
20. Mathematical model-based decision-support procedures in operational management *(László Pokorádi)*
21. Conservation of artifacts made from synthetic fibers using materials science methods *(Marianna Halász, Gábor Tamás Orosz)*
22. Solvent retention capacity of cellulose-based packaging materials *(Rozália Szentgyörgyvölgyi, Szilvia Klébert)*
23. Study of the material composition and weaving techniques of natural-based textile fabrics that form part of cultural heritage *(Tünde Tóth)*
24. Industrial CT-based optimization of additive manufacturing processes *(Ágota Horváthné Drégelyi-Kiss)*
25. Friction and load-bearing characteristics of metal/polymer and polymer/polymer material pairs *(Mihály Réger)*
26. Development of new joints in bow structures, material development, fiber reinforcement, surface treatment, and weight reduction using modern materials and composites *(Enikő Réka Fábián)*
27. Biopolymer-hydroxyapatite for bioapplication fields *(Csaba Balázsi, Katalin Balázsi)*
28. Hybrid polymer/ceramic filters for water purification *(Csaba Balázsi, Katalin Balázsi)*
29. Investigation and development of the surface properties and tribological behavior of advanced, multilayer PVD/PACVD coatings for use in plastic industry tools *(Mária Marosné Berkes)*
30. Development of a polymer liner material for hydrogen tanks, taking manufacturing technology aspects into account *(Ferenc Ronkay, Attila Bata)*
31. Development of plastics suitable for hydrogen storage for Type 4 and Type 5 tanks *(Ferenc Ronkay, Attila Bata)*
32. PET recycling: molecular and morphological changes during processing *(Ferenc Ronkay)*
33. Production of nanofiber structures using a melt-spinning centrifugal fiber formation process *(Enikő Bitay)*

b) Ceramics

Engineering ceramics and various composites reinforced with glass, metal, plastic, carbon fibers, etc., are being used to an ever-increasing extent. The investigation of the macro- and microstructures of these materials contributes to the optimization of their properties according to the requirements of the application area.

1. Development of silicon nitride ceramics containing carbon nanotubes and graphene *(János Dusza)*
2. Development of superhard ceramic coatings *(János Dusza)*
3. Application of SiC as a cladding for nuclear reactor fuel elements *(Zoltán Hózer)*
4. Investigation of microwave absorbers *(Zoltán Károly, Szilvia Klébert)*
5. Preparation of calcium phosphate-based layers and fibers and investigation of their structural properties *(Katalin Balázsi)*
6. Preparation and investigation of aluminum CNT and graphene nanocomposites *(Katalin Balázsi, Csaba Balázsi)*

7. Synthesis, structural characterization, and microscopy of advanced zirconia-based ceramics and composites *(Katalin Balázsi, Csaba Balázsi)*
8. Synthesis, structural and tribological characterization, and microscopy of silicon nitride-based advanced ceramics and composites *(Katalin Balázsi, Csaba Balázsi)*
9. Study of polymer-ceramic-metal composite systems *(Károly Belina)*
10. Development of ceramic coatings by atomization and characterization of their structure *(Csaba Balázsi, Katalin Balázsi)*
11. Development of calcium phosphate-based bioceramics using various separation technologies *(Csaba Balázsi, Katalin Balázsi)*
12. Mathematical model-based decision-preparation procedures in operational management *(László Pokorádi, Amir Asavi)*
13. Biopolymer-hydroxyapatite for bioapplication fields *(Csaba Balázsi, Katalin Balázsi)*
14. Hybrid polymer/ceramic filters for water purification *(Csaba Balázsi, Katalin Balázsi)*
15. Increasing the fracture toughness of high-entropy ceramics with nano-additives *(János Dusza)*
16. Ceramic substrates for chip applications *(Csaba Balázsi, Katalin Balázsi)*

c) Metals

Mechanical engineers encounter metals frequently during their MSc studies. We also recommend research topics tailored to their interests, as well as to materials engineers, light industry engineers, chemists, and physicists with relevant expertise in the field.

1. Measurement and estimation of segregation characteristics formed during continuous casting of steels *(Mihály Réger)*
2. Stability of centerline segregation *(Mihály Réger)*
3. Materials science aspects of resistance welding parameter optimization *(Gyula Bagyinszki)*
4. Production and characterization of steels strengthened by nanostructured oxide dispersion *(Csaba Balázsi, Katalin Balázsi)*
5. Experimental and numerical investigation of creep and thermal expansion in zirconium tubes *(Zoltán Hózer)*
6. The effect of hydrogen on the properties of nuclear reactor fuel cladding *(Zoltán Hózer)*
7. Testing and Examination of Cladding Designs for Accident-Tolerant Fuel in Nuclear Power Plants (Zoltán Hózer)
8. Perdynamic modeling of nonlinear deformation of solid bodies *(Viktor Gonda)*
9. Modeling of creep deformation in the presence of direct current *(Endre Ruszinkó)*
10. Study of polymer-ceramic-metal composite systems *(Károly Belina)*
11. Applicability of joining technologies for fixing drill bit segments *(Gyula Bagyinszki)*
12. Investigation of semi-solid-state forming *(Viktor Gonda, Mihály Réger)*
13. Development of biocompatible materials for 3D printing *(Tünde Kovács)*
14. Creep in soldering materials: finite element analysis *(Viktor Gonda)*
15. Modeling of additive manufacturing technology *(Viktor Gonda)*
16. Investigation of micro- and macro-accuracy of free-form milled surfaces *(Balázs Mikó)*
17. Analysis of dimensional measurements using computed tomography *(Ágota Drégelyi-Kiss)*
18. Investigations on measurement uncertainty of feature measurements of CMMs *(Ágota Drégelyi-Kiss)*

19. Toolpath optimization for machining free-form surfaces with a ball-end mill *(Balázs Mikó)*
20. Optimization of the dimensional chain considering design and manufacturing aspects *(Balázs Mikó)*
21. Optimization of measurement points in coordinate measurement technology *(Balázs Mikó)*
22. Ultrasound and Irreversible Deformation of Metals *(Endre Ruszinkó)*
23. The effect of ultrasonic welding on microstructure and mechanical properties *(Tünde Kovács)*
24. Deformation mechanisms and performance of ECAP-processed Al alloys and composites *(Viktor Gonda)*
25. Mathematical model-based decision-preparation procedures in operational management *(László Pokorádi)*
26. Development of surface treatment technology to improve implant-tissue integration for titanium alloy implants manufactured using 3D printing *(Tünde Kovács, Hajnalka Hargitai)*
27. Dynamic arc stabilization options for consumable-electrode gas-shielded MIG/MAG robotic welding *(Károly Széll)*
28. Investigation of the characteristics of surface layers *and* coatings *(Richárd Horváth)*
29. Investigation of the formation mechanism of welding cracks (*Tünde Kovács)*
30. The Effects of Different Heat Treatments on the Nitridation Efficiency of 3D-Printed Titanium Alloys *(Tünde Kovács, László Tóth)*
31. Development of design guidelines for additive manufacturing technologies *(Richárd Horváth)*
32. Modeling of transformation processes in a welding heat cycle *(Mihály Réger)*
33. Investigation of the metallurgical and mechanical properties of a clad reactor structural component *(Judit Pázmán)*
34. Technological investigation of stir friction welding *(Richárd Horváth)*
35. Behavior of microalloyed steels during manufacturing processes *(Enikő Réka Fábián)*
36. Development and application of modern non-destructive testing methods in a nuclear power plant environment *(Gábor Pór)*
37. Plastic deformation under linear load paths *(Endre Ruszinkó)*
38. Friction and load-bearing characteristics of metal/polymer and polymer/polymer material pairs *(Mihály Réger)*
39. Cryogenic heat treatment of tool steels *(Péter Pinke, László Tóth)*
40. Effect of shielding gases on ultraviolet radiation generated during arc welding *(Tünde Anna Kovács, Péter Pinke)*
41. Changes in the microstructure of nuclear reactor fuel elements under accident conditions *(Zoltán Hózer)*
42. Structural integrity issues in large-scale pressure vessel systems *(Zoltán Hózer)*
43. Life cycle analysis: processes related to electric battery manufacturing *(György Györök)*
44. The effect of heat treatments on the efficiency of nitriding in 3D-printed titanium alloys *(Tünde Anna Kovács)*
45. Enhancing the wear resistance of dental implants manufactured using additive technology through PVD coating *(Tünde Anna Kovács)*
46. Microstructural changes occurring during thermal cutting of high-strength steels *(Enikő Réka Fábián)*
47. Applicability of high-entropy alloys for surfaces exposed to wear *(Enikő Réka Fábián)*
48. Investigation of the oxidation conditions and stability of high-entropy alloys intended for high-temperature applications *(Enikő Réka Fábián)*
49. Development of manufacturing technology and reliability testing of lead-free brazes *(Viktor Gonda)*

50. Comprehensive investigation of machinability in various difficult-to-machine alloys *(Enikő Réka Fábián, Balázs Mikó)*
51. Investigation of geometric tolerances and manufacturability in modern tool materials *(Balázs Mikó)*
52. Extension of precision casting technology through the introduction of new materials and processes (*Enikő Bitay)*
53. Investigation of surface roughness in various machining processes
    Investigation of Surface Roughness in Different Cutting Processes *(Balázs Mikó)*
54. The effect of surface roughness on the metrological characteristics of CT measurements *(Ágota Horváthné Drégelyi-Kiss)*
55. Hydrogen diffusion and its interaction with inclusions in large steel castings *(András Mucsi)*
56. Further development of a non-destructive neutron diffraction testing method based on flight time measurement for archaeological and other museum metal objects to determine and refine spatial and directional characteristics *(Zsolt Kasztovszky)*
57. Manufacturing technology and wear testing of cosine cam pairs *(Richárd Horváth)*
58. Investigation and development of the surface properties and tribological behavior of modern, multilayer PVD/PACVD coatings applicable to plastic industry tools *(Mária Marosné Berkes)*
59. Possibilities for the simultaneous heat treatment of maraging steels *(Mihály Réger, Richárd Horváth)*
60. Investigation of manufacturing technologies for powder-based alloys *(Zsolt Ferenc Kovács)*
61. Measurements in ultra-low magnetic fields and their applications in materials science studies *(Zsófia Márkusné Bebesi)*
62. Analysis of the effects of multiple surface thermochemical heat treatment *(Richárd Horváth, Tamás Réti)*
63. Development of intelligent material models and their application in vehicle dynamics through the integration of machine learning methods *(Attila Bata)*
64. Investigation of the material properties of reactor cladding *(Ferenc Gillemot, Márton Király)*
65. Aging mechanisms of structural materials in research reactors and their microstructural characteristics in light of damage induced by various environmental and operational loads *(Ferenc Gillemot)*
66. Analysis of the relationship between surface and depth hardness distribution *(Richárd Horváth, Mihály Réger)*
67. Biocompatible materials and composites *(Tünde Anna Kovács, János Kónya)*
68. Production and investigation of magnetically functional, medium- and high-entropy alloys *(Zsófia Márkusné Bebesi, Ádám Vida)*
69. Development of a porous heat sink *(Ferenc Safranyik)*
70. Development of heat-resistant and creep-resistant alloys optimized for precision casting (Attila Diószegi, Enikő Bitay)

d) Composites

1. Gel composites containing carbon nanoparticles *(Krisztina Nagyné László)*
2. Preparation and investigation of nanocomposites with polymer matrix *(Andrea Ádámné Major)*
3. Study of polymer-ceramic-metal composite systems *(Károly Belina)*
4. Preparation and application of organic-inorganic nanocomposites in artificial photosynthesis *(József Sándor Pap)*

5. Preparation and investigation of aluminum CNT and graphene nanocomposites *(Katalin Balázsi, Csaba Balázsi)*
6. Synthesis, structural analysis, and microscopy of advanced zirconia-based ceramics and composites *(Katalin Balázsi, Csaba Balázsi)*
7. Production, structural and tribological analysis, and microscopy of advanced silicon nitride-based ceramics and composites *(Katalin Balázsi, Csaba Balázsi)*
8. Development of new bonds in bow structures, material development, fiber reinforcement, surface treatment, and weight reduction using modern materials and composites *(Enikő Réka Fábián)*
9. Improving the efficiency of impregnation technology used in the winding of electric motors for the automotive industry *(Mária Marosné Berkes)*
10. Investigation and development of the tribological behavior of state-of-the-art, multilayer super-hard coatings *(Mária Marosné Berkes)*
11. Biopolymer-hydroxyapatite for bioapplication fields *(Csaba Balázsi, Katalin Balázsi)*
12. Hybrid polymer/ceramic filters for water purification *(Csaba Balázsi, Katalin Balázsi)*
13. Biocompatible materials and composites *(Tünde Anna Kovács, János Kónya)*

e) Micro- and nanosystems, functional materials

Micro- and nanotechnologies are the result of the latest technological advancements; their application has brought about breakthroughs in numerous fields and enabled the development of new functions. Within this topic, the faculty of the doctoral school focuses on the study of complex nanostructures, as well as the fabrication and characterization of metal- and semiconductor-based systems, while also addressing specific nanotechnology-based properties of metals. Basic research on organometallic frameworks, fullerenes, and carbon nanotubes contributes to the development of composite technology. The analysis of microcontaminants in water has environmental significance.

1. Functional gels containing biologically active molecules *(Krisztina Nagyné László)*
2. Gel composites containing carbon nanoparticles *(Krisztina Nagyné László)*
3. Study of complex nanostructures using infrared spectroscopy *(Katalin Kamarás)*
4. Memory properties of silicon nitride-based non-volatile memory structures *(Zsolt József Horváth)*
5. Preparation and characterization of nanostructured oxide-dispersion-strengthened steels *(Csaba Balázsi, Katalin Balázsi)*
6. Electrical properties of metal-compound semiconductor contacts *(Zsolt József Horváth)*
7. Investigation of molecular beam epitaxial nanostructures and the technical conditions for their fabrication (*Ákos Nemcsics)*
8. Modeling the Particulate Behavior of RHEED Oscillations Using the MC Method (*Ákos Nemcsics)*
9. Investigation of semiconductor-electrolyte interfaces for solar cell applications *(Ákos Nemcsics)*
10. Investigation of modern, unconventional solar cells *(Ervin Rácz)*
11. Investigation of selective reactions in organometallic frameworks *(Éva Kováts)*
12. Supramolecular and coordination solids *(Sándor Pekker, Éva Kováts)*

13. Fabrication and application of micro-scale force-sensing structures based on piezoresistive and piezoelectric principles *(Andrea Csikósné Pap)*
14. Characterization of light absorption and scattering by suspended matter in natural waters based on the measurement of effective refractive index *(Miklós Serényi)*
15. Fabrication of calcium phosphate-based layers and fibers and investigation of their structural properties *(Katalin Balázsi)*
16. Preparation and investigation of aluminum CNT and graphene nanocomposites *(Katalin Balázsi, Csaba Balázsi)*
17. Investigation of multimodal microsystems implantable into nervous tissue *(Zoltán Fekete)*
18. Novel computing technology using phase-change materials *(Krisztián Kohány)*
19. Novel flexible and high-resolution display technology *(Krisztián Kohány)*
20. Research on polymer-based biosensors *(Gergely Márton)*
21. Optical investigation of nanostructured thin films (Miklós Fried)
22. Design and application of sensors for detecting heavy metal ions in our environment *(Abdul Shaban)*
23. Synthesis and application of organic-inorganic nanocomposites in artificial photosynthesis *(József Sándor Pap)*
24. From macromolecules with branched topologies to smart polymers *(Béla Iván)*
25. Synthesis and characterization of aluminum CNT and graphene nanocomposites *(Katalin Balázsi, Csaba Balázsi)*
26. Synthesis and structural characterization of calcium phosphate-based layers and fibers *(Katalin Balázsi)*
27. Integrated microfluidic / Lab-on-a-Chip systems for point-of-care medical diagnostic applications *(Péter Fürjes)*
28. Living tissue on a silicon scaffold – Organ-on-a-Chip devices *(Péter Fürjes)*
29. Creating “twistronic” devices with layered materials *(Péter Nemes-Incze)*
30. Low-dimensional nanostructures for the optical detection of biomolecules and gases *(Péter Petrik)*
31. Zero-dimensional nanostructures for improving the efficiency of GaAs-based solar cells *(Ákos Nemcsics)*
32. Combinatorial Preparation and Characterization Methods for High-Throughput Study of Advanced Functional Materials *(Miklós Fried)*
33. Non-destructive optical mapping tool made from inexpensive components *(Miklós Fried)*
34. Sensor Circuits Realized Using Thin-Film Technology *(Andrea Csikósné Pap)*
35. Development of composite materials for electromagnetic interference (EMI) shielding *(Réger Mihály)*
36. Modeling calculations and validation measurements of object activation in novel research facilities *(Péter Zagyvai, László Szentmiklósi)*
37. Acoustic metamaterials and their application in noise reduction (Lívia Pintér Cveticanin)
38. Production of porous materials using electrochemical processes *(László Péter)*
39. Microfluidic systems in analytical applications for pharmaceutical active ingredients *(András Füredi, Péter Fürjes)*
40. Combinatorial Sputtering and Characterization of Advanced Metal Oxide-Based Sensors and Devices *(Zoltán Lábadi)*
41. Thermal Issues in Solar Cells *(Ákos Nemcsics)*
42. Multicomponent Nanoparticles and Assemblies as Novel Platforms for (Electro)catalysis *(Dániel Zámbó)*
43. Materials science investigation of nanostructures composed of elements belonging to Group IV *(Ádám Gali)*

44. New electrode materials for biopotential measurements *(Gergely Márton)*
45. Computational photocatalysis *(András Stirling)*
46. Development and application of two-phase microfluidic systems for bioanalytical purposes *(Péter Fürjes)*
47. Development of new joints in bow structures, material development, fiber reinforcement, surface treatment, and weight reduction using modern materials and composites *(Enikő Réka Fábián)*
48. Investigation of the laser damage threshold of innovative optical elements *(Péter Dombi, Péter Rácz)*
49. Integrated MEMS force sensors in medical technology *(Péter Fürjes, János Volk)*
50. Research on materials science and technological processes supported by bio-inspired methods *(Imre Felde)*
51. Improving the efficiency of impregnation technology used in the winding of electric motors for the automotive industry *(Mária Marosné Berkes)*
52. Investigation and development of the tribological behavior of modern, multilayer super-hard coatings *(Mária Marosné Berkes)*
53. Biopolymer-hydroxyapatite for bioapplication fields *(Csaba Balázsi, Katalin Balázsi)*
54. Hybrid polymer/ceramic filters for water purification *(Csaba Balázsi, Katalin Balázsi)*
55. Increasing the fracture toughness of high-entropy ceramics with nano-additives *(János Dusza)*
56. Scanning probe analysis of layered van der Waals materials and their heterostructures *(Péter Nemes-Incze)*
57. *Investigation and development of perovskite photoelectrodes suitable for solar energy utilization (Mátyás Dabóczi)*
58. *Ceramic substrates for chip applications (Csaba Balázsi, Katalin Balázsi)*

f) Environmental protection

Materials science also plays an important role in solving environmental problems. In addition to environmentally conscious development, the identification, conversion, and recycling of waste and pollutants, as well as the degradation of larger, non-biodegradable molecules to make them biodegradable, and the production of corrosion-inhibiting nano- and micro-layers are also tasks of materials science.

1. Development of biodegradable drug carriers *(Éva Kiss)*
2. Characterization of light absorption and scattering by suspended matter in natural waters based on effective refractive index measurements *(Miklós Serényi)*
3. Co-pyrolysis of biomass and plastic waste *(Zsuzsanna Novákné Czégény)*
4. Development of methods for analyzing new types of pollutants *(Zoltán Juvancz)*
5. Environmentally beneficial chemical transformations and degradation of polymers and plastics (Béla Iván)
6. The role of component characteristics and manufacturing parameters in the recyclability of various paper products *(László Koltai)*
7. Radiation-induced degradation of water-soluble antibiotics (fluoroquinolones) (Erzsébet Takács, Erzsébet Illés)
8. Acoustic metamaterials and their application in noise reduction *(Lívia Pintér Cveticanin)*

9. Thermal problems of solar cells *(Ákos Nemcsics)*
10. Intensification of small wastewater treatment plants using microorganisms immobilized on carrier materials and automated control technology based on mathematical relationships *(Rita Bodáné Kendrovics, Anita Szabó)*
11. Life cycle analysis: processes related to electric battery manufacturing *(György Györök)*
12. Application of solar pyrolysis for the destruction and conversion of plastic waste *(András Zachár)*
13. Application of phase-change materials (PCM) in energy storage *(András Zachár)*

4.2. International Relations

To help participants gain international experience and build a network of contacts, ATDI supports doctoral students' participation in Óbuda University's mobility programs.

The Pannónia Scholarship Program was established by the Ministry of Culture and Innovation with the aim of providing international mobility opportunities and the chance to gain experience abroad for students, faculty, and staff at universities that have adopted the new model through scholarships. Both long-term and short-term mobility opportunities are eligible for support under the program.

The aim of the CEEPUS exchange program is to facilitate student and faculty mobility between partner institutions cooperating in the field of higher education, to organize specialized courses and student field trips, and to support the development of long-term professional cooperation in the region, thereby contributing to the strengthening of Central Europe's strategic role. The program places special emphasis on supporting research activities and joint doctoral programs.

Descriptions of the Pannónia, CEEPUS, and other mobility programs, along with details on the application process, can be found on the university's website at[4] under the "International Profile" section.

The personal academic connections of supervisors and faculty members also provide opportunities for doctoral students to travel.

5. ACADEMIC AND PUBLICATION REQUIREMENTS

5.1. Academic requirements

[4] https://uni-obuda.hu/#

On December 1, 2015, the National Assembly adopted Act CCVI of 2015 on the amendment of certain laws regulating education. Accordingly, the doctoral program consists of 8 semesters, during which the student must earn 240 credit points to obtain the certificate of completion. The general regulations regarding credits that can be earned in doctoral programs are contained in the Óbuda University Doctoral Credit Regulations [Appendix D2) of the University Doctoral and Habilitation Regulations].

The academic requirements of the doctoral program, the details and conditions for degree conferral, and the evaluation of publication and patent achievements are set forth in Chapters IV and V of the Operating Regulations.

5.2. Acceptance of Studies Outside the Doctoral School

The DI supports student mobility and recognizes achievements completed at other institutions or at external professional organizations—whether foreign or domestic—that are relevant to the doctoral program.

The conditions for the recognition of studies outside the Doctoral School are set forth in Appendix 4 of the Operating Regulations (ATDI Doctoral Credit Regulations).

The Doctoral School Council may grant partial exemption from fulfilling any element of the training requirements (academic, research, teaching) if

- the student engaged in activities relevant to the doctoral program prior to the start of the program;
- the student is participating in a partial program outside the institution (at a research institute, company, or abroad).

The Doctoral School Council is authorized to decide on the acceptance of the work program for partial studies outside the institution. The credit value of courses completed in this manner is determined by the Doctoral School Council (30 working hours are equivalent to 1 credit).

5.2. Recognition of studies outside the Doctoral School

The DI supports student mobility and recognizes academic achievements completed at other institutions or at external professional organizations—whether foreign or domestic—that are relevant to the doctoral program.