Óbuda University

Doctoral School of Materials Science and Technology

Curriculum

Updated
based on Resolution No. 98 (February 17, 2025) of the Doctoral School Council

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1. AIM OF THE PROGRAM

The aim of the Doctoral School of Materials Science and Technology (ATDI) is to train professionals who have comprehensive, coherent knowledge of the broad field of materials science, specialize in a field relevant to their research, and are able to use their knowledge to carry out independent, creative work in the field of materials science and its practical applications. The Doctoral School strives to ensure that graduates are able to manage research and projects, develop new research proposals, carry out their work on a solid scientific and ethical basis, and thus become capable of holding their own in both higher education/research and other areas of the labor market.

Training and research areas: The subjects and topics offered by the doctoral school cover several sub-areas, *in line with the complex nature of materials science*. This enables *students* to *acquire coherent knowledge of the diverse fields of materials science* during their training and research.
The subjects offered by the doctoral school include foundational courses providing *general knowledge of materials science and materials testing*, as well as courses covering *polymers, ceramics, metals, composites, micro- and nanostructured materials, and* certain relevant subfields *of environmental protection*. *Depending on their research topic, students must choose and complete a total of eight subjects from the foundation and sub-area subjects under the guidance of their supervisor during the first four semesters.* The research topics can also be summarized according to the above classification. Due to the complexity of materials science, both the subjects and the topics cover more than one of the above sub-areas.

Faculty and supervisors of the doctoral school
The training and research of the doctoral school is carried out by lecturers and researchers from Óbuda University, as well as guest lecturers and supervisors from other universities in the country (Budapest University of Technology and Economics, University of Debrecen, Eötvös Loránd University, University of Sopron, Neumann János University).
The doctoral school cooperates on a contractual basis with the HUN-REN Hungarian Research Network Energy Research Center (HUN-REN EK), the Wigner Research Centre for Physics (HUN-REN Wigner FK), the Research Centre for Natural Sciences (HUN-REN TTK), Neumann János University, the University of Dunaújváros and Bay Zoltán Applied Research Public Benefit Ltd.

2. KNOWLEDGE REQUIRED FOR ADMISSION TO THE DOCTORAL PROGRAM (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 thorough, master's-level knowledge of materials in a technical/natural science field during their previous training.

Typical prerequisites for the program include a master's degree 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, or physics.

The 2023 amendment to the Nftv. allows for the parallel completion of master's and doctoral programs. The details and conditions of this are set out in Section 15(3a-c) of the EDHSZ.

3. DOCTORAL SCHOOL TRAINING

3.1. Structure of the program

We offer general and specialized knowledge of materials science, grouped according to the established fields of materials science. Some subjects appear in more than one place because, due to the coherence of materials science, they touch on several subfields. In addition to professional subjects, research methodology subjects are also offered.

3.2. Structure of the doctoral school's educational program

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

- Subjects: at least ***48 credits***, with a value of ***6 credits*** per subject. A maximum of 10 courses (60 credits) can be taken into account in the final examination.
- Research project: ***10 credits/semester*** (***total*** for 8 semesters***: max. 80 credits***)
- Semesterly (written and oral) research report (***total*** for 8 semesters***: 64 credits***):
  - ***Semesters 1-4: 6 credits*****,**

- ***5th-8th semester: 10 credits***
- Publications related to the research topic: ***at least 75 credits*** according to the evaluation included in EDHSZ D2 and ATDSZ Annex 5.
- Participation in education: ***maximum 60 credits*** (no mandatory minimum), 1 contact hour per week (1x45 minutes) = 2 credits.

As part of the training, students must take a minimum of 8 subjects (4 core and 4 elective) and pass the exams.

Foundation subjects: 4 subjects must be chosen from the range of foundation subjects (general materials science 1.1, materials science testing methods, research methodology).
Elective subjects: Students may choose four subjects from among all subjects offered by the doctoral school (both foundational and specialized), with the approval of their supervisor. In accordance with the relevant regulations, students may also fulfill their academic requirements by completing subjects taken at other doctoral schools.

The structure of the courses and the order of the mandatory reports are shown in the table below:

Sample curriculum, course structure

	Semester							
	1	2	3	4	5.	6.	7.	8.
Foundation subject 1	X							
Foundation subject 2	X							
Foundation subject 3		X						
Foundation subject 4		X						
Elective subject 1.			X					
Elective subject 2.			X					
Elective subject 3.				X				
Elective subject 4.				X				
Research project	X	X	X	X	X	X	X	X
Research report	X	X	X	X	X	X	X	X

3.3 Doctoral School subjects

The following list contains the subjects announced so far in the doctoral school. Subjects marked as "archived" in the list will not be offered and are no longer available for selection. At the beginning of each semester, depending on the number of interested students and the availability of instructors, a decision is made on whether to offer each non-archived course. Descriptions of the courses that can be offered can be found on the doctoral school's Hungarian[1] and English[2] websites.

1 BASIC SUBJECTS (6 credits)

1.1 General Materials Science

1.1.1 Physical Chemistry of Surfaces (Krisztina László)
1.1.2 Porous materials (Krisztina László)
1.1.3 Nanotechnology – chemical materials science (Éva Kiss)
1.1.4 Fundamentals of radiation chemistry (László Wojnárovits)
1.1.5 Solid state chemistry (András Stirling)
1.1.6 Color chemistry (András Víg)
1.1.7 Introduction to Plasma Chemistry (Szilvia Klébert)
1.1.8 Fracture Mechanics (Tünde Kovács)
1.1.9 Analysis of Damage Processes in Structural Materials (Tünde Kovács)
1.1.10 Technological process design (Balázs Mikó)
1.1.11 Finite element modeling of material technologies (Viktor Gonda)
1.1.12 Basic knowledge of technical ceramics (Szilvia Klébert)
1.1.13 Contemporary concepts in catalysis (Sándor Pap József)
1.1.14 Biomaterials for medical applications (Csaba Balázsi)
1.1.15 The impact of Industry 4.0 on manufacturing technology (Balázs Mikó)
1.1.16 Model testing of technical systems (László Pokorádi)
1.1.17 Model testing of operational processes (László Pokorádi)
1.1.18 Nuclear power plant materials (Zoltán Hózer)
1.1.19 Fundamentals of materials science (Mária Marosné Berkes)

1.2 Material testing methods

1.2 Selected chapters from materials testing methods I. (Erzsébet Takács, Judit Telegdi)
1.2 Selected chapters from material testing methods II. (Szilvia Klébert)
1.2.3 Modern separation methods in materials research (Zoltán Juvancz)
1.2.4 Fluorescence spectroscopy and microscopy (Gusztáv Schay)
1.2.5 Modern mass spectrometry (Sándor Kéki)
1.2.6 Color science and color measurement (Ákos Borbély)
1.2.7 Examination of surface microgeometry and microtopography (Gabriella Farkas)

[1] https://atdi.uni-obuda.hu/tantargyak/
[2] https://atdi.uni-obuda.hu/en/home/ ~ Subjects

1.2.8 Finite element modeling of heat transfer (Sándor Borza)
1.2.9 Fracture mechanics (Tünde Kovács)
1.2.10 Analysis of damage processes in structural materials (Tünde Kovács)
1.2.11 Electrochemical methods for measuring corrosion and inhibition (Shaban Ibdewi Abdul)
1.2.12 Finite element modeling of material technologies (Viktor Gonda)
1.2.13 Measurement of bioelectrical activities (Gergely Márton)
1.2.14 Chemical sensors: methods and applications (Shaban Abdul)
1.2.15 Archived BioMEMS: miniaturized biosensors (Zoltán Fekete)
1.2.16 Optical characterization of thin films (Péter Petrik)
1.2.17 Structural analysis of various materials using transmission electron microscopy (Katalin Balázsi)
1.2.18 Numerical methods for evaluating optical measurements (Péter Petrik)
1.2.19 State-of-the-art surface testing (Mária Marosné Berkes)
1.2.20 Thermal and fluid dynamics modeling and numerical simulation in materials technology (András Zachár)
1.2.21 Application of inductively coupled plasma mass spectrometry in analytical chemistry (Éva Széles)
1.2.22 Physical testing of textile clothing materials (Mariann Halász)

1.3 Research methodology

1.3 Experiment design and evaluation (Ágota Drégelyi-Kiss)
1.3 Statistical hypothesis testing (Márta Takács)
1.3.3 Engineering education (Péter Tóth)
1.3.4 Writing and publishing scientific works (Tünde Kovács)

2 SUB-FIELD SUBJECTS IN MATERIAL SCIENCE (6 credits)

2.1 Polymers
2.1.1 Chemistry and Physics of Polymers (Sándor Pekker)
2.1.2 Physics of macromolecules (Károly Belina)
2.1.3 Characterization and modification of polymer surfaces (Éva Kiss)
2.1.4 Archived Natural and natural-based polymers (Cecília Tamásné Nyitrai)
2.1.5 Cellulose chemistry (Judit Borsa)
2.1.6 Paper industry fiber materials and their surface characteristics (László Koltai)
2.1.7 Cellulose and paper production (László Koltai)
2.1.8 Mechanical and physical properties of paper and corrugated products (László Koltai)
2.1.9 Interaction between archived printing substrates and printing inks during printing (Rozália Szentgyörgyvölgyi)
2.1.10 Synthetic fibers and technical textiles (Judit Borsa)
2.1.11 Applications of high-energy radiation for modifying the properties of natural polymers and plastics (Erzsébet Takács)
2.1.12 Characterization of functional textile and clothing products (Lívia Kokasné Palicska)

2.1.13 Characteristics of antimicrobial raw materials used in the light industry (Bayoumi Hamuda Hosam)
2.1.14 The use of polymers in microtechnology (Andrea Csikósné Pap)
2.1.15 Archived Polymer-based bionic interface technology and applications (Zoltán Fekete)
2.1.16 Supramolecular and coordination complexes and polymers (Sándor Pekker, Éva Kováts)
2.1.17 Biomaterials for medical applications (Csaba Balázsi)
2.1.18 Investigation of plastics and plastic-based composites (Andrea Ádámné Major)
2.1.19 Structure of polymers (Andrea Ádámné Major)
2.1.20 Fiber chemistry (Tünde Tóth)
2.1.21 Protein-based sheet systems (Tünde Tóth)
2.1.22 Engineering polymers (Mária Marosné Berkes)

2.2 Ceramics

2.2.1 Basic knowledge of technical ceramics (Szilvia Klébert)
2.2.2 Technology of technical ceramics (János Dusza)
2.2.3 Material structure and fracture mechanism of technical ceramics (János Dusza)
2.2.4 Mechanical properties of technical ceramics (János Dusza)
2.2.5 Knowledge of powder technology (Csaba Balázsi)
2.2.6 Archived BioMEMS: miniaturized biosensors (Zoltán Fekete)
2.2.7 Biomaterials for medical applications (Csaba Balázsi)
2.2.8 Technical ceramics (Mária Marosné Berkes)

2. Metals

2.3.1 Phenomena related to continuous steel casting (Mihály Réger)
2.3.2 Modeling thermally activated transformation processes in alloys (Tamás Réti)
2.3 Concentrated energy input material technologies (Gyula Bagyinszki)
2.3.4 Welding technologies I: Bulk welding (Gyula Bagyinszki)
2.3.5 Welding technologies II: Pressure welding (Gyula Bagyinszki)
2.3.6 Powder Technology (Csaba Balázsi)
2.3.7 Fundamentals of Plasticity (Endre Ruszinkó)
2.3.8 Non-classical problems of plasticity and creep (Endre Ruszinkó)
2.3.9 Electrochemical methods for measuring corrosion and inhibition (Shaban Ibdewi Abdul)
2.3.10 Cutting theory (Richárd Horváth)
2.3.11 Titanium and titanium alloys (Péter Pinke)
2.3.12 Materials used in nuclear power plants (Zoltán Hózer)
2.3.13 Electrochemical metal separation (László Péter)

2.4 Composites

2.4 Composites (Szilvia Klébert)
2.4.2 Polymer-based nanocomposites (Andrea Major Ádámné)
2.4.3 Biomaterials for medical applications (Csaba Balázsi)

2.4.4 Finite element analysis of structures built from composite materials (András Zachár)

2.5 Micro- and nanostructured systems

2.5 Semiconductor technologies (Zsolt József Horváth)
2.5.2 Semiconductor devices (Zsolt József Horváth)
2.5.3 Archived Semiconductors produced from liquid phase (Vilmos Rakovics)
2.5.4 Archived Composite semiconductors and their optoelectronic applications (Vilmos Rakovics)
2.5.5 Solid-state light sources and their applications (Zsolt József Horváth)
2.5.6 Band gap engineering (or the efficiency of solar cells) (Ákos Nemcsics)
2.5.7 Self-organizing low-dimensional systems (Ákos Nemcsics)
2.5.8 Nanotechnology – chemical materials science (Éva Kiss)
2.5.9 Medical applications of colloidal systems (Gergő Gyulai)
2.5.10 Characterization and modification of polymer surfaces (Éva Kiss)
2.5.11 The application of microcapsules in modern industry (Judit Telegdi)
2.5.12 The application of polymers in microtechnology (Andrea Csikósné Pap)
2.5.13 Adhesive-free slice bonding (Andrea Csikósné Pap)
2.5.14 Elements and compounds in micro-scale gas sensors (Andrea Csikósné Pap)
2.5.15 Molecular beam epitaxy of III-V semiconductors (Ákos Nemcsics)
2.5.16 Archived Polymer-based bionic interface technology and applications (Zoltán Fekete)
2.5.17 Archived BioMEMS: miniaturized biosensors (Zoltán Fekete)
2.5.18 Chemical sensors: methods and applications (Shaban Abdul)
2.5.19 Supramolecular and coordination complexes and polymers (Sándor Pekker, Éva Kováts)
2.5.20 Optical characterization of thin films (Péter Petrik)
2.5.21 Measurement of bioelectrical activities (Gergely Márton)

2.6 Certain environmental aspects of materials science technologies

2.6.1 Environmental Chemistry (Shaban Abdul)
2.6.2 Recycling plastic waste through pyrolysis (Zsuzsanna Czégény)
2.6.3 Going Green… Environmentally Friendly Printing (Csaba Horváth)
2.6 Wastewater treatment technologies (Rita Bodáné Kendrovics)
2.6.5 Hydrological basics (Emőke Bardóczyné Székely)
2.6.6 Hydrobiology (Rita Bodáné Kendrovics)
2.6.7 Life cycle analysis (Ákos Nemcsics)
2.6.8 Environmental product declaration (Ákos Nemcsics)
2.6.9 Environmental impacts of the electronics industry (Ákos Nemcsics)

3.4 Materials Science Seminar

Lectures given by renowned guest speakers on various topics in the diverse field of materials science are designed to give students researching a particular topic and taking courses related to that topic a broad overview of materials science and to acquire *coherent knowledge of materials science* to the extent possible. The materials science seminar is worth 3 credits, and participation is certified by the lecturer's signature.

4. RESEARCH AND INTERNATIONAL RELATIONS OF THE DOCTORAL SCHOOL

4.1 Research topics

The research topics announced since the founding of the doctoral school are grouped by subject area and listed in the following chapters. Some topics appear in more than one place because, due to the coherence of materials science research, they touch on 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 or in summary form). By selecting the "current" field on the website, you can see the list of doctoral research topics announced for the given semester.

Research topics:

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

a) Polymers

A significant part of polymer chemistry and technology research is focused on processing different sources of cellulose, the most abundant renewable raw material in nature, developing new functions, and recovering cellulose-based raw materials. Technical and innovative plastics represent topics in which generally applicable testing methods can be learned and polymers with intelligent behavior and environmentally beneficial properties can be developed.

1. Investigation of the properties of eco-fibers *(János Dusza)*

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

2. The role of incidental wood materials in the formation of colored wood defects *(Levente Albert)*
3. Degradation of wood caused by UV lasers *(György Papp)*
4. Application of transverse sound waves to 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 process parameters in the recyclability of various paper products *(László Koltai)*
7. Production and application possibilities 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 copolymer and its 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 apolar 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 branched topology macromolecules to intelligent polymers *(Béla Iván)*
16. Environmentally beneficial chemical conversion and degradation of polymers and plastics *(Béla Iván)*
17. Development of biodegradable drug carriers *(Éva Kiss)*
18. Stress-optical examination of polymer-containing hybrid composite structures processed using laser beam technologies *(Lajos Borbás)*
19. Research into polymer-based biosensors *(Gergely Márton)*
20. Mathematical model-based decision-making procedures in operations management *(László Pokorádi)*
21. Preservation of artificial fiber artworks 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 knotting techniques of natural 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 bonds in bow structures, material development, fiber reinforcement, surface treatment, and weight reduction using modern materials and composites *(Enikő Réka Fábián)*
27. Biopolymer-hydroxiapatite for bioapplication fields *(Csaba Balázsi, Katalin Balázsi)*
28. Hybrid polymer/ceramic filters for water cleaning *(Csaba Balázsi, Katalin Balázsi)*
29. Investigation and development of the surface technology and tribological behavior of modern, multi-layer PVD/PACVD coatings applicable to plastic industry tools *(Mária Marosné Berkes)*

30. Development of raw materials for polymer liners 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)*

b) Ceramics

Technical ceramics and various composites reinforced with glass, metal, plastic, carbon fiber, etc. are becoming increasingly popular. Examining the macro- and microstructure of these materials helps optimize their properties according to the requirements of their application.

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 power plant fuel elements *(Zoltán Hózer)*
4. Investigation of microwave absorbers *(Zoltán Károly, Szilvia Klébert)*
5. Production of calcium phosphate-based layers and fibers and investigation of their structural properties *(Katalin Balázsi)*
6. Production and examination of aluminum CNT and graphene nanocomposites *(Katalin Balázsi, Csaba Balázsi)*
7. Production, structural examination and microscopy of modern zirconium oxide-based ceramics and composites *(Katalin Balázsi, Csaba Balázsi)*
8. Production, structural and tribological examination and microscopy of modern silicon nitride-based 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-making procedures in operations management *(László Pokorádi, Amir Asavi)*
13. Biopolymer-hydroxiapatite for bioapplication fields *(Csaba Balázsi, Katalin Balázsi)*
14. Hybrid polymer/ceramic filters for water cleaning *(Csaba Balázsi, Katalin Balázsi)*
15. Increasing the fracture toughness of high-entropy ceramics with nano-additives *(János Dusza)*

c) Metals

Mechanical engineers encounter metals frequently in their MSc studies. We offer research topics tailored to their interests, as well as to those of materials engineers, light industry engineers, chemists, and physicists with relevant knowledge of the subject.

1. Measuring and estimating the enrichment characteristics that develop during continuous steel casting *(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 nanostructured oxide-dispersed reinforced steels *(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 power plant fuel cladding *(Zoltán Hózer)*
7. Testing and examination of cladding designs for accident tolerant fuel of nuclear power plants (Zoltán Hózer)
8. Peridynamic modeling of nonlinear deformation of solid bodies *(Viktor Gonda)*
9. Modeling creep deformation in the presence of direct current *(Endre Ruszinkó)*
10. Study of polymer-ceramic-metal composite systems *(Károly Belina)*
11. Applicability of bonding technologies for fixing drill bit segments *(Gyula Bagyinszki)*
12. Investigation of semi-solid state deformation *(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 computer tomography *(Ágota Drégelyi-Kiss)*
18. Investigations on measurement uncertainty of feature measurements of CMMs *(Ágota Drégelyi-Kiss)*
19. Toolpath optimization for free-form surface machining with a ball-nose cutter *(Balázs Mikó)*
20. Optimization of the size chain taking into account design and manufacturing considerations *(Balázs Mikó)*
21. Optimization of measurement points in coordinate measurement technology *(Balázs Mikó)*
22. Ultrasound and irrecoverable deformation of metals *(Endre Ruszinkó)*
23. Effect of ultrasonic welding on tissue structure and mechanical properties *(Tünde Kovács)*
24. Deformation mechanisms and performance of ECAP processed Al alloys and composites *(Viktor Gonda)*
25. Mathematical model-based decision-making procedures in operations management *(László Pokorádi)*
26. Development of surface treatment technology to improve the integration of 3D-printed titanium alloy implants and tissue *(Tünde Kovács, Hajnalka Hargitai)*
27. Dynamic arc stabilization possibilities in consumable electrode gas-shielded MIG/MAG robot 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 different heat treatment effects for the nitridation efficiency of the 3D printed Titanium alloy *(Tünde Kovács, László Tóth)*
31. Development of design guidelines for additive manufacturing technologies *(Richárd Horváth)*
32. Modeling transformation processes in welding heat cycles *(Réger Mihály)*
33. Examination of the metallurgical and mechanical properties of a clad reactor structural element *(Judit Pázmán)*
34. Technological investigation of friction stir welding *(Richárd Horváth)*
35. Behavior of microalloyed steels during manufacturing technologies *(Enikő Réka Fábián)*
36. Development and application of modern non-destructive material testing methods in a nuclear power plant environment *(Gábor Pór)*
37. Plastic deformation on curved load paths *(Endre Ruszinkó)*

38. Friction and load-bearing characteristics of metal/polymer and polymer/polymer material pairs *(Mihály Réger)*
39. Deep-freeze heat treatment of tool steels *(Péter Pinke, László Tóth)*
40. The effect of shielding gases on ultraviolet radiation generated during arc welding *(Tünde Anna Kovács, Péter Pinke)*
41. Changes in the material structure of nuclear power plant fuel elements under accident conditions *(Zoltán Hózer)*
42. Structural integrity issues in large pressure 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 titanium alloys produced by 3D printing *(Tünde Anna Kovács)*
45. Increasing the wear resistance of dental implants manufactured using additive technology with PVD coating *(Tünde Anna Kovács)*
46. Material structure changes during thermal cutting of high-strength steels *(Enikő Réka Fábián)*
47. The applicability of high-entropy alloys on surfaces exposed to wear *(Enikő Réka Fábián)*
48. Investigation of the oxidation conditions and stability of high-entropy alloys intended for high-temperature use *(Enikő Réka Fábián)*
49. Development of manufacturing technology and reliability testing of lead-free solder joints *(Viktor Gonda)*
50. Complex investigation of machinability in the case of various difficult-to-machine alloys *(Enikő Réka Fábián, Balázs Mikó)*
51. Investigation of geometric tolerances and manufacturing capabilities in modern tool materials *(Balázs Mikó)*
52. Extension of precision casting technology through the introduction of new materials and new processes (*Enikő Bitay)*
53. Investigation of surface roughness in the case of different cutting processes (Balázs Mikó)

    Investigation of surface roughness in the case of 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 drive pairs *(Richárd Horváth)*
58. Investigation and development of the surface technology and tribological behavior of modern, multi-layer PVD/PACVD coatings applicable to plastic industry tools *(Mária Marosné Berkes)*
59. Possibilities for simultaneous heat treatment of maraging steels *(Mihály Réger, Richárd Horváth)*
60. Investigation of powder-based alloy manufacturing technology *(Zsolt Ferenc Kovács)*

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. Production 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. Production, structural investigation and microscopy of modern zirconium oxide-based ceramics and composites *(Katalin Balázsi, Csaba Balázsi)*
7. Production, structural and tribological testing and microscopy of modern 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. Increasing 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 modern, multi-layer super-hard coatings *(Mária Marosné Berkes)*
11. Biopolymer-hydroxiapatite for bioapplication fields *(Csaba Balázsi, Katalin Balázsi)*
12. Hybrid polymer/ceramic filters for water cleaning *(Csaba Balázsi, Katalin Balázsi)*

e) Micro- and nanosystems, functional materials

Micro- and nanotechnologies are the result of the latest technological developments, and their application has led to breakthroughs in many areas, enabling the creation of new functions. Within this topic, the faculty of the doctoral school study complex nanostructures and the production and characterization of metal- and semiconductor-based systems, also touching on certain nanotechnology-based characteristics of metals. Basic research on metal-organic frameworks, fullerenes, and carbon nanotubes contributes to the development of composite technology. The analysis of water micropollutants is important for environmental protection.

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 non-volatile memory structures based on silicon nitride *(Zsolt József Horváth)*
5. Production and characterization of nanostructured oxide-dispersed reinforced steels *(Csaba Balázsi, Katalin Balázsi)*
6. Electrical properties of metal-compound semiconductor contacts *(Zsolt József Horváth)*
7. Investigation of molecular beam epitaxy nanostructures and technical conditions for their production (*Ákos Nemcsics)*
8. Modeling of the particulate behavior of RHEED oscillations using the MC method (*Ákos Nemcsics)*
9. Investigation of semiconductor-electrolyte transition for solar cell applications *(Ákos Nemcsics)*

10. Investigation of modern, unconventional solar cells *(Ervin Rácz)*
11. Investigation of selective reactions in metal-organic frameworks *(Éva Kováts)*
12. Supramolecular and coordination solids *(Sándor Pekker, Éva Kováts)*
13. Production and application of micrometer-scale force measuring devices operating on piezoresistive and piezoelectric principles *(Andrea Csikósné Pap)*
14. Characterization of light absorption and scattering of suspended matter in natural waters based on effective refractive index measurements *(Miklós Serényi)*
15. Production of calcium phosphate-based layers and fibers and investigation of their structural properties *(Katalin Balázsi)*
16. Production and examination of aluminum CNT and graphene nanocomposites *(Katalin Balázsi, Csaba Balázsi)*
17. Investigation of multimodal microsystems implantable into nerve tissue *(Zoltán Fekete)*
18. Novel computing technology using phase-change materials *(Krisztián Kohány)*
19. Novel flexible and high-resolution screen technology *(Krisztián Kohány)*
20. Research into polymer-based biosensors *(Gergely Márton)*
21. Optical examination of nanostructured thin films (Miklós Fried)
22. Design and application of sensors for detecting heavy metal ions in our environment *(Shaban Abdul)*
23. Production and application of organic-inorganic nanocomposites in artificial photosynthesis *(József Sándor Pap)*
24. From branched topology macromolecules to smart polymers *(Béla Iván)*
25. Production and examination of aluminum CNT and graphene nanocomposites *(Katalin Balázsi, Csaba Balázsi)*
26. Preparation 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 optical sensing of biomolecules and gases *(Péter Petrik)*
31. Zero-dimensional nanostructures for increasing the efficiency of GaAs-based solar cells *(Ákos Nemcsics)*
32. Combinatorial Preparation and Characterization Methods for High Through-put Study of Advanced Functional Materials *(Miklós Fried)*
33. Non-destructive optical mapping tool from cheap parts *(Miklós Fried)*
34. Sensor circuits implemented with thin-film technology *(Andrea Csikósné Pap)*
35. Development of composite materials for electromagnetic interference (EMI) shielding *(Mihály Réger)*
36. Modeling calculations and validation measurements of activation of objects 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 drug substances *(András Füredi, Péter Fürjes)*
40. Combinatorial Sputtering and Characterization of Advanced Metal Oxide Based Sensors and Devices *(Zoltán Lábadi)*
41. Thermal problems of 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 bonds 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 into materials science and technological processes supported by bio-inspired methods *(Imre Felde)*
51. Increasing 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, multi-layer super-hard coatings *(Mária Marosné Berkes)*
53. Biopolymer-hydroxiapatite for bioapplication fields *(Csaba Balázsi, Katalin Balázsi)*
54. Hybrid polymer/ceramic filters for water cleaning *(Csaba Balázsi, Katalin Balázsi)*
55. Increasing the fracture toughness of high-entropy ceramics with nano-additives *(János Dusza)*
56. Scanning probe investigation 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)*

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 molecules that are not biodegradable, thereby making 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 of suspended matter in natural waters based on effective refractive index measurement *(Miklós Serényi)*
3. Combined pyrolysis of biomass and plastic waste *(Zsuzsanna Novákné Czégény)*
4. Development of a new type of pollutant analysis *(Zoltán Juvancz)*
5. Environmentally beneficial chemical conversion and degradation of polymers and plastics (Béla Iván)
6. The role of component characteristics and manufacturing process parameters in the recyclability of various paper products *(László Koltai)*

7. Radiation-induced degradation of antibiotics (fluoroquinolones) dissolved in water (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 attached to 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

ATDI supports the participation of doctoral students in the mobility programs of Óbuda University in order to help them gain international experience and build a network of contacts.

Thanks to the Erasmus+ program, higher education institutions can establish partnerships to promote the internationalization of higher education, and their students, teachers, and staff can participate in foreign mobility programs.

The Pannonia Scholarship Program was established by the Ministry of Culture and Innovation with the aim of providing international mobility opportunities and foreign experience for students, teachers, and staff of model-changed universities through scholarships. Both long-term and short-term mobility can be supported under the program.

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

Descriptions of the Pannonia, Erasmus+, CEEPUS, and other mobility programs, as well as information on the application process, can be found on the university's website at[4] under "International Profile."

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

5. STUDY REQUIREMENTS

5.1. Study requirements

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

On December 1, 2015, the National Assembly passed Act CCVI of 2015 on the amendment of certain laws regulating education. Accordingly, doctoral training lasts eight semesters, during which students must earn 240 credit points to obtain an absolutorium from . The general regulations governing the credits that can be earned in doctoral programs are contained in the Óbuda University Doctoral Credit Regulations [University Doctoral and Habilitation Regulations, Appendix D2).

The doctoral program consists of two phases: the first four semesters are the "training and research" phase, and the second are the "research and dissertation" phase. At the end of the fourth semester, as a conclusion to the training and research phase and as a prerequisite for the start of the research and dissertation phase, a comprehensive exam must be passed, which measures and evaluates academic and research progress.

Those who have prepared for the degree individually may also join the doctoral program, provided that they have met the admission and doctoral program requirements. In this case, student status is established upon application for and acceptance to the comprehensive exam.

In the theoretical part of the comprehensive examination, the examinee takes an exam in at least two and at most three subjects/topics. In the second part of the comprehensive examination, the examinee gives a presentation on their knowledge of the literature, reports on their research results, and presents their research plan for the second stage of the doctoral program, as well as the schedule for the preparation of the dissertation and the publication of the results.

Doctoral candidates must submit their doctoral dissertation within three years of passing the comprehensive examination.

5.2. Acceptance of studies outside the doctoral school

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

- the student has pursued activities relevant to the doctoral program prior to the start of the program;
- the student participates in partial training 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 training outside the institution. The credit value of courses completed in this manner is determined by the Doctoral School Council.