AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: BioSurface Engineering

Academic year: 2019/2020 Code: CIMT-2-408-MF-s ECTS credits: 3

Faculty of: Materials Science and Ceramics

Field of study: Materials Science Specialty: —

Study level: Second-cycle studies Form and type of study: Full-time studies

Lecture language: English Profile of education: Academic (A) Semester: 4

Course homepage: —

Responsible teacher: prof. dr hab. inż. Pamuła Elżbieta (epamula@agh.edu.pl)

Module summary

The students are introduced to different methods of a defined design of biomaterials surface properties taking into account biological phenomena and available manufacturing methods.

Description of learning outcomes for module

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Connections with FLO	Method of learning outcomes verification (form of completion)
Social competence: is able to			
M_K001	Is able to work in a team and communicate pieces of information on biosurface engineering in a clear and comprehensive way		Presentation
Skills: he can			
M_U001	Is able to propose modification method of different biomaterials for use in contact with different tissues		Presentation
M_U002	Knows the principles of immobilization of biologically active molecules on biomaterials' surface		Presentation
Knowledge: he knows and understands			
M_W001	Knows how surface chemistry, topography as well as mechanical and physical factors influence cellular response		Test
M_W002	Knows different methods for a defined design of biomaterials' surface properties		Test

Number of hours for each form of classes

	Form of classes										
Suma	Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
30	0	0	0	0	0	30	0	0	0	0	0

FLO matrix in relation to forms of classes

MLO code	Student after module completion has the knowledge/ knows how to/is able to	Form of classes										
		Lectures	Auditorium classes	Laboratory classes	Project classes	Conversation seminar	Seminar classes	Practical classes	Fieldwork classes	Workshops	Prace kontrolne i przejściowe	Lektorat
Social competence: is able to												
M_K001	Is able to work in a team and communicate pieces of information on biosurface engineering in a clear and comprehensive way	-	-	-	-	-	+	-	-	-	-	-
Skills: he can												
M_U001	Is able to propose modification method of different biomaterials for use in contact with different tissues	-	-	-	-	-	+	-	-	-	-	-
M_U002	Knows the principles of immobilization of biologically active molecules on biomaterials' surface	-	-	-	-	-	+	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	Knows how surface chemistry, topography as well as mechanical and physical factors influence cellular response	-	-	-	-	-	+	-	-	-	-	-
M_W002	Knows different methods for a defined design of biomaterials' surface properties	-	-	-	-	-	+	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	30 h
Preparation for classes	10 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	20 h
Realization of independently performed tasks	20 h
Summary student workload	80 h
Module ECTS credits	3 ECTS

Additional information

Module content

Seminar classes

The course aims to introduce to the students different methods for a defined design of biomaterials surface properties with special attention paid to

- the biological background,
- the methods to generate the surface property profile,
- the biologically wanted surface property as well as
- relevant results from cell biological experiments, animal testing, and clinical trials.

This includes (i) methods to create defined surface morphologies via physical and chemical processing, (ii) physical and chemical modifications of surface properties, (iii) inorganic coating systems, and (iv) the whole area of BioSurface Engineering, i.e. the biomimetic imitation of the native cellular microenvironment given by the properties of the native extracellular matrix (ECM).
This will enable students to design biomaterials surfaces from various substrates for biomedical applications in different areas such as tissue engineering and regenerative medicine for use in contact with different tissues.
Topics:
1.Biofunctionality, cell communication and surfaces
2.Surface morphology and cellular response
3.Physico-chemical surface properties and cellular response
4.Mechanical and physical factors influencing cellular response
5.Introduction to BioSurface Engineering
6.Strategies for immobilization I
7.Strategies for immobilization II
8.Peptides
9.Components of the extracellular matrix
10.Growth factors and cytokines

Teaching methods and techniques:

Seminar classes: Na zajęciach seminaryjnych podstawą jest prezentacja multimedialna oraz ustna prowadzona przez studentów. Kolejnym ważnym elementem kształcenia są odpowiedzi na powstałe pytania, a także dyskusja studentów nad prezentowanymi treściami.

Warunki i sposób zaliczenia poszczególnych form zajęć, w tym zasady zaliczeń poprawkowych, a także warunki dopuszczenia do egzaminu:

Positive marks from tests and presentation

Zasady udziału w poszczególnych zajęciach, ze wskazaniem, czy obecność studenta na zajęciach jest obowiązkowa:

Seminar classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Studenci prezentują na forum grupy temat wskazany przez prowadzącego oraz uczestniczą w dyskusji nad tym tematem. Ocenie podlega zarówno wartość merytoryczna prezentacji, jak i tzw. kompetencje miękkie.

Method of calculating the final grade

The algorithm of the final mark calculation: test 1 (1/3), test 2 (1/3), presentation (1/3)

Sposób i tryb wyrównywania zaległości powstałych wskutek nieobecności studenta na zajęciach:

In case of an absence from the seminar classes immediately contact the teacher.

Prerequisites and additional requirements

Basic course of chemistry, physics, materials science, knowledge of English

Recommended literature and teaching resources

Biomaterials Science, Edited by Ratner et al., Elsevier, 2012.
Titanium in Medicine, Edited by Brunette et al., Springer, 2001.
Molecular Biology of the Cell, Edited by Alberts et al., Taylor & Francis, 2004.

Scientific publications of module course instructors related to the topic of the module

1. Wojak-Ćwik, I.M., Rumian, Ł., Krok-Borkowicz, M., [et al.], Scharnweber, D., Pamuła, E. Synergistic effect of bimodal pore distribution and artificial extracellular matrices in polymeric scaffolds on osteogenic differentiation of human mesenchymal stem cells Materials Science and Engineering C 97, 2019, 12-22.
2. Małgorzata Krok-Borkowicz, Elena Filova, Jaroslav Chlupac, Jan Klepetar, Lucie Bacakova, Elżbieta Pamuła, Influence of pore size and hydroxyapatite deposition in poly(l-lactide-co-glycolide) scaffolds on osteoblast-like cells cultured in static and dynamic conditions, Materials Letters 241, 2019, 1-5.
3. Ł. Rumian, H. Tiainen, U. Cibor, M. Krok-Borkowicz, M. Brzychczy-Włoch, H. J. Haugen, E. Pamula, Ceramic scaffolds with immobilized vancomycin-loaded poly(lactide-co-glycolide) microparticles for bone defects treatment, Materials Letters 190, 2017, 67-70.
4. T. E.L. Douglas, G. Krawczyk, E. Pamula, [et al.], Generation of composites for bone tissue-enginnering applications consisting of gellan gum hydrogels mineralized with calcium and magnesium phosphate phases by enzymatic means, Journal of Tissue Engineering and Regenerative Medicine 10(11), 2016, 938–954.

Additional information

None