AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Advanced ceramic biomaterials

Academic year: 2019/2020 Code: ZSDA-3-0062-s ECTS credits: 3

Faculty of: Szkoła Doktorska AGH

Field of study: Szkoła Doktorska AGH Specialty: —

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

Lecture language: English Profile of education: Academic (A) Semester: 0

Course homepage: —

Responsible teacher: dr inż. Zima Aneta (azima@agh.edu.pl)

Module summary

Student after module completion has the knowledge of advanced bioceramic materials used in tissue engineering and regenerative medicine. Knows the practical aspects of using various bioceramic as a implant materials.

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	Student is able to develop new materials and technologies that can be useful for the biomaterial science.	SDA3A_K01	Activity during classes
Skills: he can			
M_U001	Student can indentify and solve problems in material science	SDA3A_U01, SDA3A_U02	Activity during classes
Knowledge: he knows and understands			
M_W001	Student knows the advantages and disadvatages of application of advanced ceramic biomaterials as a implant materials.	SDA3A_W02	Activity during classes
M_W002	Student knows the theoretical background of different bioceramic materials used in medicine.	SDA3A_W01	Activity during classes

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
20	8	0	0	0	0	12	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	Student is able to develop new materials and technologies that can be useful for the biomaterial science.	+	-	-	-	-	+	-	-	-	-	-
Skills: he can												
M_U001	Student can indentify and solve problems in material science	+	-	-	-	-	+	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	Student knows the advantages and disadvatages of application of advanced ceramic biomaterials as a implant materials.	+	-	-	-	-	+	-	-	-	-	-
M_W002	Student knows the theoretical background of different bioceramic materials used in medicine.	+	-	-	-	-	+	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	20 h
Preparation for classes	2 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	4 h
Realization of independently performed tasks	4 h
Examination or Final test	2 h
Contact hours	2 h
Summary student workload	34 h
Module ECTS credits	3 ECTS

Additional information

Module content

Lectures

1. Characteristics and applications of various forms of ceramic implants.
2. Calcium phosphate based bioceramics. New trends in research on CaPs bioceramics.
3. Bone cements.New generation of bone cements.
4. Bioceramics for dentistry.
5. Ceramic coatings on metallic implants.
6. Ceramic homogeneous and heterogeneous drug carriers.
7. Oxide bioceramics.
8. The inorganic-organic and inorganic-inorganic composites. Hybrid materials.

Seminar classes

- Ceramic implant materials – the range and function of porosity in medical applications.
- The significance of hybrid materials for implantology.
- Bioceramics for dental application.
- Bioceramics in the treatment of bone diseases and injuries.
- Bioceramics as coatings on implant materials
- Calcium phosphate based materials.
- Oxide bioceramics.

Teaching methods and techniques:

Lectures: Lectures:
The lecture is provided in the form of a multimedia presentations.
Seminar classes: Seminar classes: Students discuss during seminars on the application of the advanced ceramic biomaterals.

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

The conditions and manner of passing classes will be given at the first lecture.

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

Lectures:
– Attendance is mandatory: No
– Participation rules in classes: Lectures:
- Attendance is mandatory: No
Seminar classes:
– Attendance is mandatory: Yes
– Participation rules in classes: Seminar classes:
- Attendance is mandatory: Yes
- Participation rules in classes: The basis for seminar classes run by students is giving the multimedia and oral presentation as well as discussion on the presented content.

Method of calculating the final grade

Final grade = 0.5 • grade for oral presentation + 0.5 • grade for test.

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

The conditions will be discussed at the first lecture.

Prerequisites and additional requirements

Basic knowledge of bioceramic science.

Recommended literature and teaching resources

1. LeGeros, R. Z. (2002). Properties of osteoconductive biomaterials: calcium phosphates. Clinical Orthopaedics and Related Research (1976-2007), 395, 81-98.
2. Antoniac, I. V. (Ed.). (2016). Handbook of bioceramics and biocomposites (pp. 1-2). Berlin, Germany:: Springer.
3. Hench, L. L. (1991). Bioceramics: from concept to clinic. Journal of the american ceramic society, 74(7), 1487-1510.
4. Vallet-Regi, M. (2014). Bio-ceramics with clinical applications. John Wiley & Sons.
5. Kokubo, T. (Ed.). (2008). Bioceramics and their clinical applications. Elsevier.
6. Bohner, M. (2000). Calcium orthophosphates in medicine: from ceramics to calcium phosphate cements. Injury, 31, D37-D47.
7. Ginebra, M. P., Traykova, T., & Planell, J. A. (2006). Calcium phosphate cements as bone drug delivery systems: a review. Journal of controlled release, 113(2), 102-110.
8. Montufar, E. B., Vojtova, L., Celko, L., & Ginebra, M. P. (2017). Calcium phosphate foams: Potential scaffolds for bone tissue modeling in three dimensions. In 3D Cell Culture (pp. 79-94). Humana Press, New York, NY.
9. de Groot, K. (2018). Bioceramics Calcium Phosphate: 0. CRC press.
10. Dorozhkin, S. V. (2018). Current State of Bioceramics. JOURNAL OF CERAMIC SCIENCE AND TECHNOLOGY, 9(4), 353-370.

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

1. Zima A., Siek D., Czechowska J., Olkowski R., Noga M., Lewandowska-Szumieł, Ślósarczyk A., *How calcite and modified hydroxyapatite influence physicochemical properties and cytocompatibility of alpha-TCP based bone cements,* Journal of Materials Science. Materials in Medicine 28 (8) (2017) 117-128.
2.Czechowska J., Zima A., Siek D., Ślósarczyk A., Influence of sodium alginate and methylcellulose on hydrolysis and physicochemical properties of α-TCP based materials, Ceramics International 44 (2018)

6533-6540.
3.Zima A., Hydroxyapatite-chitosan based bioactive hybrid biomaterials with improved mechanical strength, Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 193 (2018) 175-184.
4.Zima A., Czechowska J., Siek D., Ślósarczyk A., Influence of magnesium and silver ions on rheological properties of hydroxyapatite/chitosan/calcium sulphate based bone cements, Ceramics International 43 (2017) 16196-16203.
5. Dziadek, M., Kudlackova, R., Zima, A., Slosarczyk, A., Ziabka, M., Jelen, P., ... & Surmeneva, M. A. (2019). Novel multicomponent organic-inorganic WPI/gelatin/CaP hydrogel composites for bone tissue engineering. Journal of Biomedical Materials Research Part A.
6. Cichoń, E., Haraźna, K., Skibiński, S., Witko, T., Zima, A., Ślósarczyk, A., ... & Guzik, M. (2019). Novel bioresorbable tricalcium phosphate/polyhydroxyoctanoate (TCP/PHO) composites as scaffolds for bone tissue engineering applications. Journal of the mechanical behavior of biomedical materials.
7. Belcarz A., Zima A., Ginalska G., Biphasic mode of antibacterial action of aminoglycoside antibiotics-loaded elastic hydroxyapatite-glucan composite, International Journal of Pharmaceutics 454 (2013) 285-295.
8. Czechowska J., Zima A., Paszkiewicz Z., Lis J., Ślósarczyk A., Physicochemical properties and biomimetic behavior of α-TCP-chitosan based materials, Ceramics International 40 (04) (2014) 5523-5532.
9. M. Potoczek, A. Zima, Z. Paszkiewicz, A. Ślósarczyk, Manufacturing of highly porous calcium phosphate bioceramics via gel-casting using agarose. Ceramics International, Vol. 35(6), 2249–2254, 2009
10. T.E.L. Douglas, J. Schietse, A. Zima, S. Gorodzha, B.V. Parakhonskiy, D. KhaleNkow, R. Shkarin, A. Ivanova, T. Baumbach, V. Weinhardt, C.V. Stevens, V. Vanhoorne, C. Vervaet, L. Balcaen, F. Vanhaecke, A. Ślósarczyk, M.A. Surmeneva, R. Surmenev, A.G. Skirtach, Novel self-gelling injectable hydrogel/alpha-tricalcium phosphate composites for bone regeneration: physiochemical and microcomputer tomographical characterization, Journal of Biomedical Materials Research. Part A., Vol. 106 (3), pp. 822-828, 2018

Additional information

None