

**AGH**AGH UNIVERSITY OF SCIENCE
AND TECHNOLOGY

Module name: **Materials Science in Space Technologies**

Academic year: **2019/2020** Code: **CIMT-2-417-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: **<http://home.agh.edu.pl/~zbgrzesik>**

Responsible teacher: **prof. dr hab. inż. Grzesik Zbigniew (grzesik@agh.edu.pl)**

Module summary

Students obtain essential information about materials applied in space technologies. They will gain knowledge on threats in universe and protection 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	has basic knowledge on space in relation to the application possibilities of novel materials		Presentation, Participation in a discussion, Activity during classes
M_K002	is creative in solving of problems		Presentation, Participation in a discussion, Activity during classes
Skills: he can			
M_U001	is able to select appropriate materials for specific application in space		Presentation, Participation in a discussion, Activity during classes
Knowledge: he knows and understands			
M_W001	has knowledge on current trends in development of new space technologies		Presentation, Participation in a discussion, Activity during classes

Number of hours for each form of classes

Suma	Form of classes										
	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	has basic knowledge on space in relation to the application possibilities of novel materials	-	-	-	-	-	+	-	-	-	-	-
M_K002	is creative in solving of problems	-	-	-	-	-	+	-	-	-	-	-
Skills: he can												
M_U001	is able to select appropriate materials for specific application in space	-	-	-	-	-	+	-	-	-	-	-
Knowledge: he knows and understands												
M_W001	has knowledge on current trends in development of new space technologies	-	-	-	-	-	+	-	-	-	-	-

Student workload (ECTS credits balance)

Student activity form	Student workload
Udział w zajęciach dydaktycznych/praktyka	30 h
Preparation for classes	30 h
przygotowanie projektu, prezentacji, pracy pisemnej, sprawozdania	5 h
Realization of independently performed tasks	15 h
Summary student workload	80 h
Module ECTS credits	3 ECTS

Additional information

Module content

Seminar classes

- Outline of space science
- Outline of space exploration
- History of satellite technology
- Present satellite technology
- Space flight technology
- Space exploration technology
- Future space technologies
- Aerospace and space materials
- Advanced materials in future space applications
- Commercialization and colonization of space

Teaching methods and techniques:

Seminar classes: The seminar classes are on the multimedia and oral presentation of the students. Other important elements are the answers given by the students to received questions and the discussion between the students on the presented topic.

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

In order to complete the course, a presentation on a chosen subject must be given and the student must take part in a discussion, which will be positively graded. In order to pass the subject in the secondary term, a positive grade must be obtained from a test on the entirety of the theoretical material.

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

Seminar classes:

- Attendance is mandatory: Yes
- Participation rules in classes: Students will present a topic provided by the lecturer in front of the group and take part in a discussion on the topic. Both the merit and the visual presentation will be graded.

Method of calculating the final grade

Final grade = 0.7 x grade from oral presentation + 0.3 x grade from participation in discussions

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

If the requirements are met for obtaining a passing grade, the student is required to independently catch up with the material. If he/she fails to do so, he/she must obtain a positive grade on a test that pertains to the material discussed during his absence.

Prerequisites and additional requirements

None

Recommended literature and teaching resources

ASM Handbook, vol. 13, Corrosion: Fundamentals, Testing and Protection. Ed. ASM International, Materials Park, Ohio USA, 2003.

High temperature materials and mechanisms. Ed. Yoseph Bar-Cohen. CRC Press, Boca Raton, London, New York, 2014.

<http://www.spaceflight.esa.int/users/materials/>

http://www.esa.int/Our_Activities/Space_Engineering_Technology/Materials_and_Processes

<https://www.nasa.gov/audience/foreducators/postsecondary/features/nasa-material.html>

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

Z. Grzesik, M. B. Dickerson, K. Sandhage, "Incongruent reduction of tungsten carbide by a zirconium-copper melt", *Journal of Materials Research*, 18, 2135-2140 (2003).

Z. Grzesik, T. Bak, J. Nowotny and B. Henry, "Chemical diffusion in amphoteric oxide semiconductors", *Advances in Applied Ceramics*, 106, 77-81 (2007).

M. Danielewski, Z. Grzesik, S. Mrowec, „On the oxidation mechanism of Ni-Pt alloys at high temperatures”, *Corrosion Science*, 53, 2785-2792 (2011).

Z. Grzesik, S. Mrowec, „High temperature corrosion of metallic materials in composed oxidizing environments”, *High Temperature Materials and Processes*, 31, 539-551 (2012).

K. Kyziół, Ł. Kaczmarek, M. Klich, Z. Grzesik, "Dependence of structure and mechanical properties of Si-DLC coatings on methane content applied in plasma modification of Al-Zn and Al-Cu T6I6 alloys", *Proceedings of 12th International Conference „Local mechanical properties 2015”*, p. 30, November 04-06, 2015, Liberec, Czech Republic.

Additional information

None