



Module name: Materials Science in Space Technologies

Academic year: 2017/2018 Code: CIM-2-317-FM-s ECTS credits: 3

Faculty of: Materials Science and Ceramics

Field of study: Materials Science Specialty: Functional Materials

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

Lecture language: English Profile of education: Academic (A) Semester: 3

Course homepage: <http://home.agh.edu.pl/~zbgrzesik>

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

Academic teachers: 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			
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			
M_U001	is able to select appropriate materials for specific application in space		Presentation, Participation in a discussion, Activity during classes
Knowledge			
M_W001	has knowledge on current trends in development of new space technologies		Presentation, Participation in a discussion, Activity during classes

### 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	Others	E-learning
Social competence												
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												
M_U001	is able to select appropriate materials for specific application in space	-	-	-	-	-	+	-	-	-	-	-
Knowledge												
M_W001	has knowledge on current trends in development of new space technologies	-	-	-	-	-	+	-	-	-	-	-

## 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

### Method of calculating the final grade

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

### 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](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

### Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in conversation seminars	30 h
Preparation of a report, presentation, written work, etc.	5 h
Realization of independently performed tasks	15 h
Preparation for classes	30 h
Summary student workload	80 h
Module ECTS credits	3 ECTS