AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Module name: Degradation of engineering materials

Academic year: 2018/2019 Code: CIM-2-313-BK-s ECTS credits: 3

Faculty of: Materials Science and Ceramics

Field of study: Materials Science Specialty: Biomateriały i kompozyty

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. nadzw. dr hab. inż. Deja Jan (deja@agh.edu.pl)
prof. dr hab. inż. Grzesik Zbigniew (grzesik@agh.edu.pl)

Module summary

Students obtain basic information about degradation processes of engineering materials applied in different branches of industry. They will gain knowledge on protection methods against degradation.

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	Rozumie potrzebę ograniczania degradacji materiałów inżynierskich zarówno w aspekcie ekonomicznym, jak i ekologicznym		Activity during classes, Participation in a discussion
M_K002	Dostrzega znaczenie badań podstawowych w procesie poznawania zjawisk fizykochemicznych, zachodzących w środowisku naturalnym i przemysłowym		Activity during classes, Participation in a discussion
Skills			
M_U001	Potrafi badać skutki degradacji materiałów i określać ich przyczyny		Presentation, Participation in a discussion
M_U002	Umie zastosować właściwe metody ograniczające degradację materiałów inżynierskich		Activity during classes, Presentation, Participation in a discussion
Knowledge			

M_W001	Zna mechanizmy procesów degradacji materiałów inżynierskich		Activity during classes, Presentation, Participation in a discussion, Test
M_W002	Zna termodynamikę procesów korozji oraz metody badań kinetyki i mechanizmu degradacji materiałów inżynierskich		Test, Presentation, Participation in a discussion

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	Rozumie potrzebę ograniczania degradacji materiałów inżynierskich zarówno w aspekcie ekonomicznym, jak i ekologicznym	-	-	-	-	-	+	-	-	-	-	-
M_K002	Dostrzega znaczenie badań podstawowych w procesie poznawania zjawisk fizykochemicznych, zachodzących w środowisku naturalnym i przemysłowym	-	-	-	-	-	+	-	-	-	-	-
Skills												
M_U001	Potrafi badać skutki degradacji materiałów i określać ich przyczyny	-	-	-	-	-	+	-	-	-	-	-
M_U002	Umie zastosować właściwe metody ograniczające degradację materiałów inżynierskich	-	-	-	-	-	+	-	-	-	-	-
Knowledge												
M_W001	Zna mechanizmy procesów degradacji materiałów inżynierskich	-	-	-	-	-	+	-	-	-	-	-
M_W002	Zna termodynamikę procesów korozji oraz metody badań kinetyki i mechanizmu degradacji materiałów inżynierskich	-	-	-	-	-	+	-	-	-	-	-

Module content

Seminar classes

1.The general introduction to the thermodynamics of gaseous corrosion at high temperatures.
2.Experimental methods used in studying oxidation of metals and oxidation rate equations.
3.Wagner’s theory of metal oxidation and dissociation theory of scale growth.
4.High temperature corrosion of engineering materials in purely oxidizing environments.
5.Liquid oxides and oxide evaporation, catastrophic oxidation.
6.Sulphide corrosion of metals and alloys.
7.Oxidation in the presence of water vapor.
8.Hot corrosion and salt-induced corrosion.
9.Corrosion in carbon containing atmospheres.
10.Oxidation in complex atmospheres.
11.High temperature corrosion in automobile industry.
12.Corrosion of ceramic materials.
13.Corrosion in aqueous environments.
14.Atmospheric corrosion. Inhibitors of corrosion.
15.Coatings for corrosion protection.

Method of calculating the final grade

Final grade = 0.8 x grade from oral presentation +0.2 x grade from participation in duscussions

Prerequisites and additional requirements

No additional requirements

Recommended literature and teaching resources

1.N. Birks, G.H. Meier and F.S Pettit, Introduction to the high temperature oxidation of metals, Cambridge, University Press, 2009.
2.W. Gao, Z. Li, High-temperature Corrosion and Protection of Materials, Woodhead Publishing in Materials, Cambridge, England, 2008.
3.ASM Handbook, Volume 13A, Corrosion: Fundamentals, Testing, and Protection. Materials Park, Ohio, USA, 2003.
4.A.S. Khanna, Introduction to High Temperature Oxidation and Corrosion, ASM International, Materials Park, 2002.
5.P. Kofstad, High Temperature Corrosion, Elsevier Applied Science, London 1988.
6.M.G. Fontana, Corrosion Engineering. Mc-Graw-Hill, 1986.
7.S. Mrowec, An Introduction to the Theory of Metal Oxidation, National Bureau of Standards and National Science Foundation, Washington D.C., 1982.
8.S. Mrowec and T. Werber, Modern Scaling-Resistant Materials, National Bureau of Standards and National Science Foundation, Washington D.C., 1982.
9.M. Pourbaix, Atlas of Electrochemical Equilibria in Aqueous Solutions. NACE International, 1966.

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

1.Z. Grzesik, S. Mrowec, “The influence of lithium on the kinetics and mechanism of manganese sulphidation”, Corrosion Science, 48, 3186-3195 (2006).
2.Z. Grzesik, S. Mrowec, ”On the sulphidation mechanism of niobium and some Nb-alloys at high temperatures”, Corrosion Science, 50, 605-613 (2008).
3.M. Danielewski, Z. Grzesik, S. Mrowec, „On the oxidation mechanism of Ni-Pt alloys at high temperatures”, Corrosion Science, 53, 2785-2792 (2011).
4.Z. Grzesik, G. Smola, K. Adamaszek, Z. Jurasz, S. Mrowec, „High Temperature corrosion of valve steels

in combustion gases of petrol containing ethanol addition”, Corrosion Science, 77, 369-374 (2013).
5.Z. Grzesik, G. Smola, K. Adamaszek, Z. Jurasz, S. Mrowec, „Thermal shock corrosion of valve steels utilized in automobile industry”, Oxidation of Metals, 80, 147-159 (2013).
6.Z. Grzesik, M. Migdalska, S. Mrowec, „The influence of yttrium on high temperature oxidation of valve steels”, High Temperature Materials and Processes, 34, 115-121 (2015).

Additional information
No additional information

Student workload (ECTS credits balance)

Student activity form	Student workload
Participation in seminar classes	30 h
Realization of independently performed tasks	7 h
Preparation for classes	20 h
Preparation of a report, presentation, written work, etc.	15 h
Contact hours	5 h
Summary student workload	77 h
Module ECTS credits	3 ECTS