

PHD STUDIES COURSE UNIT DESCRIPTION

Subject	Field of science, code	Faculty / Center	Department
Current topics in surface engineering and applied electrochemistry	Chemistry N 003	FTMC	
Student's workload	Credits	Student's workload	Credits
Lectures		Consultations	3
Independent study	7	Seminars	

Course annotation

Electrochemical methodology and relation to other scientific fields. Electrochemistry for low carbon economy and renewable energy.

Overview of current topics of applied electrochemistry: batteries, supercapacitors, electroplating, electrochemical surface modification, electrochemical surface engineering, corrosion and protection, analytical electrochemistry, solar generation of hydrogen, and biomedical applications.

Overview of electrochemical processes: electrochemical cells and reactions; charge of electrode, electrochemical potential, electrical double layer, current-potential characteristics, Faradaic processes, pathways of electrode reaction, mass transfer, and overpotential;

Selective electrodes, basic principles of electroanalysis;

Semiconductor electrodes, photoelectrochemistry, photoelectrochemical hydrogen generation.

Electrochemistry of silicon, its photoelectrochemistry and relation to thin film solar cells.

Deposition of metals from ionic liquids and high temperature molten salts.

Electrochemical energy storage: batteries and supercapacitors. Li-ion batteries. From micro-batteries in vivo to stationary batteries in electrical grids.

Fuel cells. Hydrogen as a future energy carrier: the use of hydrogen and hydrogen-containing compounds to generate energy.

Corrosion damage, control, economic impact, protection strategies and engineering measures.

Electrochemical remediation technologies for polluted soils, sediments, and groundwater.

Reading list

- C. G. Zoski. Handbook of Electrochemistry. Elsevier, 2007.
- P. R. Roberge. Corrosion engineering. Principles and Practice. McGraw-Hill Companies, Inc. 2008.
- J. M. Diaz-Cruz, N. Serrano, C. Perez-Rafols, C. Arino, M. Esteban. Electroanalysis from the past to the twenty-first century: challenges and perspectives. *J. Solid State Electrochem.* 24 (2020) 2653-2661.
- Y. Hu, H. Huang, J. Feng, W. Wang, H. Guan, Z. Li, Z. Zou. Materials design and surface/Interface engineering of photoelectrodes for solar water splitting. *Solar RRL*, 5 (2021) 2100100.
- L. Li et al. Surface and interface engineering of nanoarrays toward advanced electrodes and electrochemical energy storage devices. *Advanced Materials*, 33 (2021) 2004959.
- E. Juzeliūnas, D. J. Fray. Silicon electrochemistry in molten salts. *Chemical Reviews* 120, 3 (2020) 1690-1709.
- Electrodeposition from ionic liquids. Eds. F. Endres, A. P. Abbot, D. R. MacFarlane. Wiley-VCH, 2008.
- C. Xu et al. Surface engineering for advanced aqueous supercapacitors: A Review. *ChemElectroChem* 7 (2020) 586-593.
- T. Song, E. Kendrick. Recent progress on strategies to improve the high-voltage stability of layered-oxide cathode materials for sodium-ion batteries. *J. Phys. Materials.* 4 (2021) 032004.

Consulting teachers	Scientific degree	Major publications in the scientific field during last 5 years
Eimutis Juzeliūnas	Habil. dr.	<p>1. E. Juzeliūnas, D. J. Fray. Silicon electrochemistry in molten salts. <i>Chemical Reviews</i> 120, 3 (2020) 1690-1709.</p> <p>2. L. Staišiūnas, K. Leinartas, E. Juzeliūnas, D. Bučinskienė, A. Grigucevičienė, P. Kalinauskas, A. Selskis, S. Stanionytė. Anticorrosion performance of hafnium oxide ultrathin films on AZ31 magnesium alloy. <i>Surface and Coatings Technology</i> 397 (2020) 126046.</p> <p>3. E. Juzeliūnas, D. J. Fray, P. Kalinauskas, I. Valsiūnas, G. Niaura, A. Selskis, V. Jasulaitienė. Electrochemical synthesis of photoactive carbon-carbide structure on silicon in molten salt. <i>Electrochemistry Communications</i> 90 (2018) 6-10.</p>
Konstantinas Leinartas	Dr.	<p>1. L. Staišiūnas, K. Leinartas, E. Juzeliūnas, D. Bučinskienė, A. Grigucevičienė, P. Kalinauskas, A. Selskis, S. Stanionytė. Anticorrosion performance of hafnium oxide ultrathin films on AZ31 magnesium alloy. <i>Surface and Coatings Technology</i> 397 (2020) 126046.</p> <p>2. L. Staišiūnas, E. Juzeliūnas, K. Leinartas, M. Skapas, A. Grigucevičienė, R. Juškėnas, D. Bučinskienė, V. Jasulaitienė. Microgravimetric study of early stages aluminum corrosion in neutral media. <i>Corrosion</i> 75(9) (2019) 1044-1050.</p> <p>3. K. Leinartas, E. Juzeliūnas, L. Staišiūnas, A. Grigucevičienė, P. Miečinskas, J. Vaičiūnienė, V. Jasulaitienė, R. Kondrotas, R. Juškėnas. Mg-Nb alloy films: structure and stability in a balanced salt solution. <i>J. Alloys and Compounds</i> 661 (2016) 322-330.</p>

Certified during Doctoral Committee session on September 28th, 2021. Protocol No. 610000-KT-142.

Committee Chairman prof. habil. dr. Aivaras Kareiva