Laboratory of Electrochemistry

HEAD:

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GROUP MEMBERS:

Piotr Połczyński, PhD
PhD students: Paweł Kulboka, Rafał Rutkowski, Maciej Słojewski
MSc students: Elwis Borecki, Agnieszka Prus

RESEARCH PROFILE:

Contributing to a better understanding of surfaces, interfaces, nanostructures and their applications. Development of synthesis methods of well-defined surfaces and nanostructured materials and investigations of processes at the interfaces by using electrochemical methods and impedance spectroscopy.

CURRENT RESEARCH ACTIVITIES:

Research covers surface/interface reactivity, ion transport, materials for heterogeneous catalysis, and electrochemical/photoelectrochemical energy conversion and storage. Our group is interested in the innovative use of the electrochemical methods in chemical science. Our work is also related to the theoretical development and the use of impedance spectroscopy for kinetic and thermodynamic studies of (electro)chemical systems under both supported and unsupported (solid state) conditions.
Impedance spectroscopy (IS) is a relatively new and powerful method allowing for the investigation of electrical properties of matter and relaxation phenomena with time constants ranging over nearly ten orders of magnitude. Electrochemical impedance spectroscopy (EIS), unlike any other electrochemical method, can provide a full insight into the mechanism and kinetics of electrode processes. We develop comprehensive explanations and theories describing different physicochemical systems allowing for a broader application of IS in material science and electrochemistry (EIS).
Our scientific research is also related to the hydrogen sorption phenomena and electrode reactions involving hydrogen adsorption and absorption in heterogeneous catalysis. Hydrogen can be considered as an ideal energy carrier, however, hydrogen storage is one of the most challenging problem to be solved

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toward the realization of the hydrogen economy. Metallic based hydrogen storage materials have an ability to reversibly absorb and release significant amount of hydrogen directly or under electrochemical conditions. Reversible hydride formation may be applied in many areas such as rechargeable batteries, hydrogen storage systems and cooling devices. Another potential application is related to hydrogen sensing. The mechanism of hydrogen absorption in metals remains still unresolved problem yet its understanding on the molecular level plays a key role during the design of novel materials of required absorption properties.

SELECTED PUBLICATIONS:

1. T. Pajkossy, R. Jurczakowski, Electrochemical impedance spectroscopy in interfacial studies. Current Opinion in Electrochemistry. 1(1) (2017) 53-58.
2. B. Łosiewicz, R. Jurczakowski, A. Lasia, Kinetics of hydrogen underpotential deposition at iridium in sulfuric and perchloric acids. Electrochim Acta. 225 (2017) 160-167.
3. P. Połczyński, R. Jurczakowski, Extremely fast hydrogen absorption/desorption through platinum overlayers, J Power Sources. 305 (2016) 233-239.
4. P. Połczyński, R. Jurczakowski, Impedance as a Tool for Rapid and Complete Characterization of Electrocatalytic Systems Involving Redox Mediators, Electrochim Acta. 188 (2016) 882-887.
5. A. Januszewska, G. Dercz, A. Lewera, R. Jurczakowski, Spontaneous Chemical Ordering in Bimetallic Nanoparticles, The Journal of Physical Chemistry C. 119(34) (2015) 19817-19825.
6. W. Adamczyk, P. Połczyński, A. Mika, T. Jaroń, Z. Mazej, K.J. Fijałkowski, R. Jurczakowski, W. Grochala, New Ag(F1-xClx) phases for energy storage applications, J Fluorine Chem. 174 (2015) 22-29.
7. R. Jurczakowski, P. Połczyński, Impedance of Mediated Electrochemical Processes. Novel Impedance Element for Unequal Diffusivities, J Phys Chem C. 118(15) (2014) 7980-7988.