

Catalysis and Physicochemistry of Surface



HEAD:

Adam Lewera*, PhD DSc

GROUP MEMBERS:

Maciej Gorzkowski, PhD

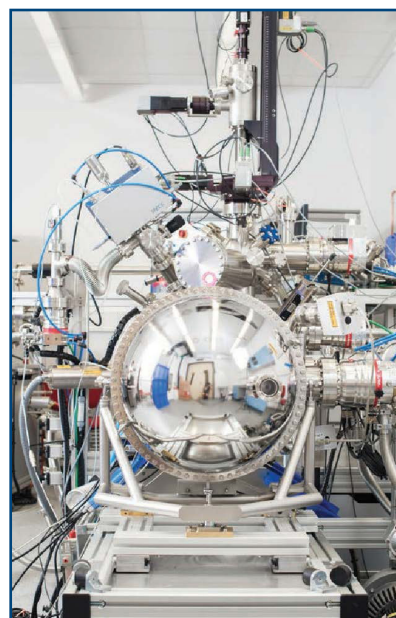
PhD students: Barbara Gralec, Justyna Piwowar,
Paweł Wnuk

RESEARCH PROFILE:

Electronic origins of catalytic activity

CURRENT RESEARCH ACTIVITIES:

The aim of the research is to gain a better understanding of the mechanisms of catalytic reactions and the factors influencing the catalytic activity. Particular emphasis is put on the relationship between the surface electronic properties and the overall catalytic activity, and also how the change in electronic properties of a given surface change the mechanisms of catalytic reactions occurring at that surface. Combination of various methods, such as X-ray Photoelectron Spectroscopy, UV-photoelectron Spectroscopy, Differential Electrochemical Mass Spectrometry and electrochemical methods allows for a better insight especially on electrocatalytic reactions. This research is closely related to developing new materials for electrodes in new sources of electricity, e.g. for low temperature fuel cells, feed with liquid fuels. This promising energy sources are still economically unviable due to low activity or anode and cathode catalysts, and developing new, more active electrocatalysts is needed in order to make low temperature fuel cells widely used.



SELECTED PUBLICATIONS:

1. B. Gralec, A. Lewera, Catalytic activity of unsupported Pd-Pt nanoalloys with low Pt content towards formic acid oxidation, *Applied Catalysis B: Environmental*. 192 (2016) 304–310.
2. M.T. Gorzkowski, A. Lewera, Probing the Limits of d-Band Center Theory: Electronic and Electrocatalytic Properties of Pd-Shell-Pt-Core Nanoparticles, *Journal of Physical Chemistry C*. 119 (2015) 18389-18395.
3. J. Seweryn, A. Lewera, High selectivity of ethanol electrooxidation to carbon dioxide on platinum nanoparticles in low temperature polymer electrolyte membrane direct ethanol fuel cell, *Applied Catalysis B: Environmental*. 144 (2014) 129-134.
4. J. Ma, A. Habrioux, C. Morais, A. Lewera, W. Vogel, Y. Verde-Gomez, G. Ramos-Sanchez, P.B. Balbuena, N. Alonso-Vante, Spectroelectrochemical probing of the strong interaction between platinum nanoparticles and graphitic domains of carbon. *ACS Catalysis*. 3 (2013) 1940-1950.
5. J. Seweryn, A. Lewera, Electrooxidation of ethanol on carbon-supported Pt-Pd nanoparticles, *Journal of Power Sources*. 205 (2012) 264–271.
6. A. Jabłoński, A. Lewera, Electrocatalytic oxidation of ethanol on Pt, Pt-Ru and Pt-Sn nanoparticles in polymer electrolyte membrane fuel cell—role of oxygen permeation, *Applied Catalysis B: Environmental*, 115–116 (2012) 25–30.
7. A. Lewera, L. Timperman, A. Roguska, N. Alonso-Vante, Metal-Support Interactions between Nanosized Pt and Metal Oxides (WO_3 and TiO_2) Studied Using X-ray Photoelectron Spectroscopy, *Journal of Physical Chemistry C*. 115(41) (2011) 20153-20159.
8. A. Jabłoński, P. Kulesza, A. Lewera, Oxygen Permeation through Nafion 117 Membrane and its Impact on Efficiency of Polymer Membrane Ethanol Fuel Cell, *Journal of Power Sources*. 196 (2011) 4714-4718.
9. Panakkattu K. Babu, A. Lewera, Jong Ho Chung, R. Hunger, W. Jaegermann, N. Alonso-Vante, A. Więckowski, E. Oldfield, Selenium Becomes Metallic in Ru-Se Fuel Cell Catalysts: An EC-NMR and XPS Investigation, *Journal of the American Chemical Society*. 129(49) (2007) 15140-15141.
10. A. Lewera, W.P. Zhou, R. Hunger, W. Jaegermann, A. Więckowski, S. Yockel, P. S. Bagus, Core-level Binding Energy Shifts in Pt-Ru nanoparticles: A puzzle resolved, *Chemical Physics Letters*. 447 (2007) 39-43.