C1. DESCRIPTION FOR THE GENERAL PUBLIC

In 1986 an American physicist Kim Eric Drexler published a book entitled: “Engines of Creation: The Coming Era of Nanotechnology”[1], in which he used a new word: “nanotechnology” for the first time. In 1991 the same scientist defended a PhD thesis on Molecular Nanotechnology at the prestige university – Massachusetts Institute of Technology (MIT). There would be nothing extraordinary about it, except that his PhD thesis was the first one of this kind in the world[2].

Although some time has passed since his defense, the nanotechnology is still developing dynamically. Production of nanoparticles and other nanoobjects currently reaches hundreds of thousands of tons and it is expected to hit over a half a million of tons in 2020[3]. Nanostructures appear more and more frequently in the everyday products, for example titanium dioxide nanoparticles in a white paint or silver nanoparticles in a facial cream – thanks to their presence a jar may be left open much longer.

Nanoparticles may also be applied in the industry. The biggest obstacle in commercialization of fuel cells is the high costs of platinum based catalyst. That’s why the researchers conducted on non-noble catalysts, which are as efficient as platinum, has crucial meaning. It is believed that smaller nanostructures should exhibit more efficient catalytic properties. However, our preliminary researches[4] indicates that, at some point, minimization of the nanostructures’ size leads to deterioration of their applicable properties hence bigger objects are more desired. Therefore, to obtain the proper size of electrodeposited, non-noble nanostructures on which the electrocatalytic reactions will be most efficient, we need to optimize the preparation procedure.

Electrocatalytic reactions occur on metallic nanocrystalites especially on their edges and peaks. When hydrogen cations or hydroxyl anions act as reagents of the process, the pH reaction of the solution is different near the surface of the catalyst than in the bulk solution.

It may trigger some interesting questions: In what place on the electrodeposited nanostructure occur the biggest changes of the pH? On the edges? On the peaks? On smaller or bigger structures? Or maybe the greatest efficiency occurs in a place where two different metals are connected?

The main objective of this project is to find answers to these questions. We have to detect these subtle changes in the pH near the surface of obtained nanostructures and to see where this changes occur. This will be possible only when we will have proper nanoscale.

In our researches we will use a modified pH nanosensor, which will be prepared during this project, and a scanning electrochemical microscope – SECM. They will be used not only to make a map of pH changing during the reaction on the surface of nanocrystalites but simultaneously they will allow us to make a scan of a topography of our sample.

The obtained results will extend the fundamental knowledge and understanding of processes occurring on multimetalic and nanostructured catalysts.

[1] K. Eric Drexler, Engines of Creation: The Coming Era of Nanotechnology, New York: Anchor Books, Doubleday 1986, ISBN 0-385-19973-2
[2] Eric Drexler’s blog: Metamodern. http://metamodern.com/about-the-author/
[3] C. O. Robichaud, A. E. Uyar, M. R. Darby, L. G. Zucker, i M. R. Wiesner, Environ. Sci. Technol., 43 (2009)4227.
[4] Nogala, W., et al., Nanoscale, 2015, 7, 10767