Functional materials for the CO2 –based electrosynthesis of ethylene oxide

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The CO2EXIDE project aims at the development of a combined electrochemical-chemical technology for the simultaneous electrocatalytic conversion of CO2 to ethylene at the cathode, water oxidation to hydrogen peroxide at the anode and a subsequent chemical conversion of both intermediates to ethylene oxide and oligo-/polyethylene glycol in a cascade reaction. Within the project duration, the final CO2EXIDE technology will undergo a thorough material and component R&D programme. A 1kW PEM electrolyser for CO2-reduction and water oxidation in combination with an ethylene enrichment unit and subsequent chemical conversion cascade reactor will be manufactured to produce ethylene oxide as intermediate for oligo-/polyethylene glycol synthesis.

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| a) |  |
| b) |

Figure 1: Possible range of nanostructures which can be obtained via different electrodeposition techniques at the Academic Centre for Materials and Nanotechnology, Kraków, with alumina templates: a) metallic bismuth (upper picture) or b) Indium-Antimony (lower picture).

For example, by using template-assisted electrodeposition it is possible to obtain hexagonally arranged nanowire arrays with huge active surface for electrocatalysis. Using e.g. 55 nm pore diameter alumina templates with 1 cm2 geometrical area to obtain 200 nm long nanowires it is possible to get material with estimated 1357 m2 active lateral surface. This can be easily improved by increasing the length of nanowires by introducing different shapes (periodically modulated or Y-branched) or by producing binary nanowires and etched on of components to obtain porous nanostructures. Examples of nanostructures obtained via template-assisted electrodeposition are presented in Figure 1.

Within the presentation, a detailed description of the CO2EXIDE project and the materials development for nanomaterials as well as 3D-electrodes will be presented.

References: Brzózka A., Brudzisz A., Hnida K., Sulka G.D. (2015) Chemical and Structural Modifications of Nanoporous Alumina and Its Optical Properties. In: Losic D., Santos A. (eds) Electrochemically Engineered Nanoporous Materials. Springer Series in Materials Science, vol 220. Springer, Cham.

Acknowledgement: This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 768789.