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# ELECTROCHEMICAL OXYGEN REDUCTION AT PLATINUM CATALYST ON TIN OXIDE BASED SUPPORT IN ALKALINE SOLUTION

Ljiljana M. Gajić-Krstajić[1], N.R. Elezović[2], B.M. Babić[3], J. Kovač[4], V.R. Radmilović[5], N.V. Krstajić[5]

*[1]Institute of Technical Sciences of SASA, Belgrade, Serbia, [2]Institute for Multidisciplinary Research, University of Belgrade, Belgrade, Serbia, [3]Vinča Institute of Nuclear Sciences, University of Belgrade, Serbia, [4]Jozef Stefan Institute, Ljubljana, Slovenia, [5]Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, Serbia*

Platinum on Sb doped tin oxide support ($Sb/SnO_2$) was synthesized and characterized as the catalyst for oxygen reduction reaction in 0.1 mol $dm^{-3}$ NaOH solution, at 25°C. Sb (5%) doped tin oxide support was synthesized by sol-gel procedure.

Platinum nanocatalyst (20% Pt) on $Sb\text{-}SnO_2$ support was synthesized by borohydride reduction method. Synthesized support and catalyst were characterized by BET (Brunauer, Emmett, Teller), X-ray diffraction (XRD), high resolution transmission electron microscopy (HRTEM) and X-ray photoelectron spectroscopy (XPS). XRD diffraction spectra of the support contained only $SnO_2$ belonging peaks. X-ray photoelectron spectroscopy was applied to characterize chemical status of elements before and after Pt-treatment. XPS spectra Sn 3d, Pt 4f, Sb 3d and O 1s revealed that the Pt-deposition on $Sb+SnO_2$ support induced reduction of Sn(4+) oxidation state to Sn(2+) and Sn(0) states, while Pt remained in metallic state and Sb was in (3+) oxidation state. Homogenous Pt nanoparticles distribution over the support, without pronounced particle agglomeration was confirmed by HRTEM technique. The average Pt particle size was 2.9 nm. Electrochemically active Pt surface area of the catalyst was determined by integration of the cyclic voltammetry curve in the potential region of underpotential deposition of hydrogen, after double layer charge correction, taking into account the reference value of 210 μC $cm^{-2}$ for full monolayer coverage. This calculation gave the value of 51 $m^2$ $g^{-1}$.

Kinetics of the oxygen reduction reaction at $Pt/Sb\text{-}SnO_2$ catalyst was studied by cyclic voltammetry and linear sweep voltammetry at rotating gold disc electrode. Two different Tafel slope were observed: one close to 60 mV $dec^{-1}$ in low current density region, and other ~120 mV $dec^{-1}$ in higher current densities region, as it was already referred in literature for oxygen reduction reaction at polycrystalline Pt, as well as at different Pt based nanocatalysts. The specific activities for oxygen reduction, expressed in terms of kinetic current densities per electrochemically Pt active surface area, as well as per mass of Pt loaded, at the constant potential of practical interest (0.85 V and 0.90 V vs RHE), were compared to carbon supported (Vulcan XC-72) catalyst. $Pt/Sb\text{-}SnO_2$ catalyst exhibited similar catalytic activity for oxygen reduction reaction like carbon supported one. The advantages of carbon free support application in terms of durability and stability of the catalysts were discussed.