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PREPARATION AND CHARACTERIZATION Pt CATALYST ON Ru DOPED TIN OXIDE SUPPORT FOR OXYGEN REDUCTION

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Platinum nanocatalyst on Ru doped tin oxide support (Ru-SnO_2) was synthesized and characterized as a catalyst for oxygen reduction reaction in 0.5 mol dm^{-3} $HClO_4$ solution, at 25°C. Ru doped tin oxide support was synthesized by sol-gel procedure. Synthesized support was characterized by BET (Brunauer, Emmett, Teller), X-ray diffraction, HRTEM (high resolution transmission electron microscopy) and cyclic voltammetry techniques. Specific surface area of the support determined from nitrogen adsorption/desorption isothermal curves was 141 m^2 g^{-1}. XRD spectra contained mainly SnO_2 belonging peaks. The corresponding crystallite size for Ru-SnO_2, determined by Scherrer's equation was 4nm.

Platinum nanocatalyst at Ru-SnO_2 support was synthesized by borohydride reduction method and characterized by X-ray and TEM techniques. Homogenous Pt nanoparticles distribution over the support, without pronounced particle agglomeration was confirmed. The average Pt particle size was 5.3 nm. Electrochemically active surface area of the catalyst was determined from adsorption/desorption charge of hydrogen atoms, after double layer charge correction, taking into account the reference value of 210 μC cm^{-2} for full monolayer coverage with adsorbed hydrogen species.

The oxygen reduction reaction at Pt/Ru-SnO_2 catalyst was studied by cyclic voltammetry and linear sweep voltammetry at rotating disc electrode. Two different Tafel slope were observed: one close to 60 mV dec^{-1} in low current density region, and other close to 120 mV dec^{-1} at high current densities region, as it was already reported in literature for oxygen reduction at pure polycrystalline Pt, as well as at Pt nanoparticles in acid solutions. The specific activities, expressed in terms of kinetic current densities per electrochemically active surface area, as well as per mass of Pt loaded, at the constant potential of practical interest, were compared to carbon supported (Vulcan XC-72) catalyst. Pt/Ru-SnO_2 catalyst exhibited similar catalytic activity for oxygen reduction reaction like carbon supported one. The durability of the catalysts was evaluated by repetitive cycling up to 1.4 V vs RHE. Better stability of Pt/Ru-SnO_2 catalyst compared to Pt on carbon support was confirmed by determination of the loss of platinum electrochemically active surface area after potential cycling tests.