EC

CORE@SHELL-STRUCTURED BINARY TiO_2@RuO_2 OXIDE SYNTHESIZED BY SPRAY PYROLYSIS FOR ELECTROCHEMICAL APPLICATIONS

Nataša Vukićević[1], Vesna Cvetković[1], Srećko Stopić[2], Jasmina Stevanović[1], Vladimir Panić[1], Bernd Friedrich[2]

e-mail: panic@ihtm.bg.ac.rs (Vladimir Panić)

1-Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Belgrade, Serbia

2-IME Process Metallurgy and Metal Recycling, RWTH Aachen University, Germany

The binary TiO_2–RuO_2 oxide is well-known constituent of the activated titanium anodes (ATA), crucial for their excellent electrocatalytic properties. There are efforts to improve the oxide synthesis procedure for highly controllable structural and consequently electrochemical performances of ATA coatings. Novel synthesis of sub-micron--sized binary oxide particles in the TiO_2 core–RuO_2 shell form (60 at.% Ru) was achieved by ultrasonic spray pyrolysis method. Basic electrochemical properties of the obtained TiO_2–RuO_2 powders were investigated in its form of a thin layer on glassy carbon deposited from the water suspension of synthesized powder. The methods used to clarify the porous layer properties upon subsequent thermal treatment in air, as required for the formation of ATA coating or supercapacitor formation, were cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) in acid solution. Fig. 1 presents the CVs of the synthesized oxide and the effects of subsequent drying or annealing on CV currents. The shape of CVs is typical for pure RuO_2 with proton-assisted redox transition response, which indicates successful core–shell structure formation. The CV shape of as-synthesized and dried TiO_2@RuO_2 is mimicking that of hydrated RuO_2, whereas the annealing produces the CV response of rutile structure. The subsequent thermal treatment causes the decrease in CV currents. The results are comparable to CV response of commercial hydrated RuO_2; however, the decrease in CV currents upon drying is less pronounced for the synthesized sample due to the placement of activeRuO_2 on TiO_2 core. It appears that the core is able to supply active O sites for good proton conductivity of the dried RuO_2 in the shell.

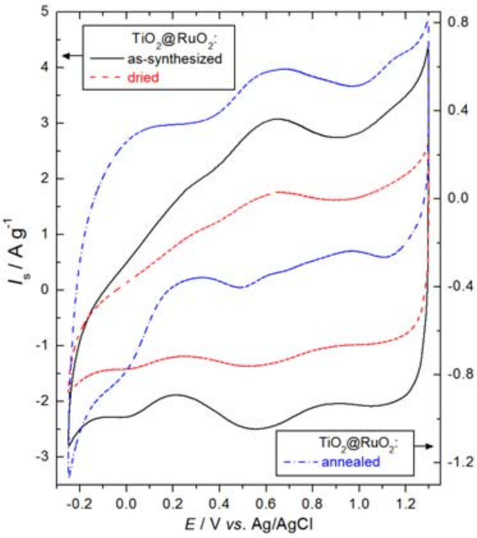

Fig. 1. CVs of TiO_2@RuO_2 synthesized by ultrasonic spray pyrolysis and subsequently dried (120 °C, 24 h) or annealed (450 °C, 30 min); 1 M H_2SO_4, 50 mV/s.

Key words electrochemically active metal oxides, activated titanium anodes, pseudocapacitance, electrochemical impedance spectroscopy.