

THE INFLUENCE OF THE SUPPORT NANOPARTICLES' COMPOSITION
IN THE ACTIVITY OF IRIIDIUM NANOPARTICLES TOWARDS OXYGEN
EVOLUTION REACTION

Blanco Redondo L., Lobko Y., Matolínová I.

Charles University, Faculty of Mathematics and Physics, Department of Surface and Plasma
Science. V Holesovickach 2, 180 00, Prague 8, Czech Republic
lublare93@gmail.com

In water electrolyzer systems, the positive electrode is one of the most important components, where the oxygen evolution reaction (OER) occurs. In this process, the water molecules are split into oxygen ions, protons, and electrons, and the oxygen gas is produced on the anode surface [1]. The state-of-the-art materials that catalyze OER are ruthenium, iridium, and their oxides, but their cost and scarcity require reduction and enhancement of their utilization [2]. One morphological approach consists of the dispersion of the active nanoparticles in support nanoparticles to increase their mass activity. However, due to the high potential reached during operating conditions for water splitting, support materials have to possess a high corrosion resistance. Titanium oxides are good candidates because of their high thermal and chemical stability, low cost, and commercial availability [3]. But their poor electric conductivity ($\sim 10^{-6}$ S cm^{-1}) makes the design of an active and stable catalyst a non-trivial task. In this work, Ir nanoparticles have been synthesized on the surface of TiO_2 (Fig. 1a,b) and TiC nanoparticles, and a complete analysis of their morphological, chemical, and electrochemical properties (Fig. 1c,d) have been carried out, including testing in situ in a single-cell water electrolyzer. The results show a successful performance of the supported Ir/ TiO_2 nanoparticles comparable to the pure Ir black nanoparticles but with an active metal loading five times lower. On the other hand, Ir/TiC has not shown the expected catalytic activity, since TiC showed excellent electrical conductivity during the ex-situ characterization, but its stability in the in-situ cell was really poor worsening the Ir nanoparticles activity.

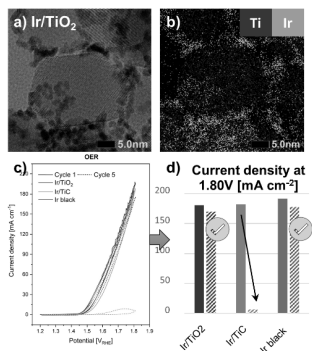


Fig. 1. TEM image of Ir/ TiO_2 (a), EDX mapping of Ir/ TiO_2 (b), linear sweep voltammetry of catalysts (c), the current density at given potential 1.80 V (d)

1. *Sadhasivam T., Ho-Young J.* Chapter 3 - Nanostructured bifunctional electrocatalyst support materials for unitized regenerative fuel cells // Nanostructured, Functional, and Flexible Materials for Energy Conversion and Storage Systems, 2020. P. 69-103.

2. *Antolini E.* Iridium as Catalyst and Cocatalyst for Oxygen Evolution/Reduction in Acidic Polymer Electrolyte Membrane Electrolyzers and Fuel Cells // ACS Catal. 2014. 4, N 5. P. 1426-1440.

3. *Van Pham C., Bühler M.* IrO₂ coated TiO₂ core-shell microparticles advance performance of low loading proton exchange membrane water electrolyzers// Applied Catalysis B: Environmental-2020. P 269. P. 118762.