Synthesis and Characterization of Au_{core}-Ir_{shell} Nanoparticles for Oxygen Evolution Reaction Catalysis

S. Sisorov[1], A. Keilin[1], D. Kaplan[1,2], G. Markovich[1], E. Peled[1]

[1]School of chemistry, Faculty of Exact Sciences, Tel-Aviv University, Tel Aviv 6997801, Israel

[2]Nuclear Research Center - Negev, Beer-Sheva, Israel, 84190

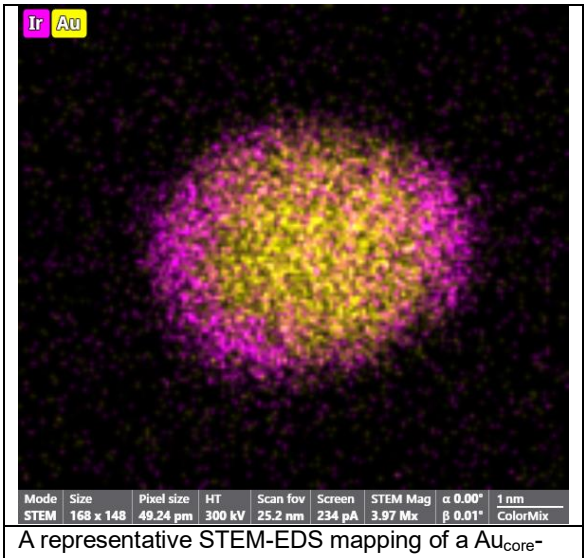
Email: gilmar@tauex.tau.ac.il, peled@tauex.tau.ac.il

The widespread production of green hydrogen through water electrolysis faces a significant challenge attributed to the high overpotential associated with the oxygen evolution reaction (OER). Catalysts play a crucial role in mitigating this overpotential, and iridium-based catalysts have demonstrated a superior balance between catalytic activity and stability. Nevertheless, the extensive scarcity and elevated cost of iridium present obstacles to the widespread adoption of pure iridium-oxide in water electrolyzers. In response to this challenge, the reduction of iridium loading on nanocatalysts has become a focal point of intensive research in both academia and the industry. Our study is dedicated to the synthesis and characterization of Au_{core}-Ir_{shell} nanoparticles with reduced iridium content as part of an effort to promote wide-scale green hydrogen production.

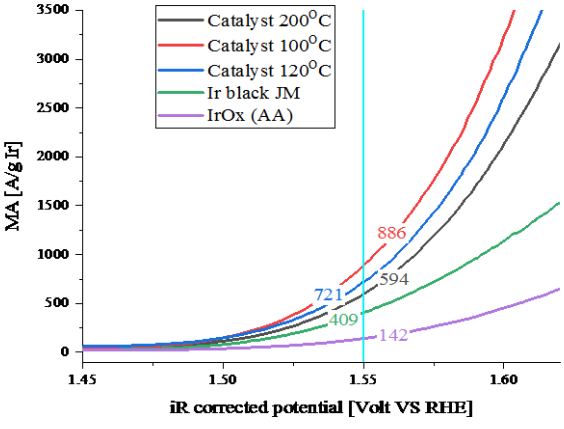
Gold nanoparticles (Au-NPs) were synthesized in ethylene glycol by the reduction of an Au-precursor with NaBH4. Subsequently, these Au-NPs were coated with Ir using the polyol method at various temperatures. The resulting catalytic powder underwent electrochemical and physical characterization to investigate its electrochemical properties, metal composition, and nanostructure.

Electrochemical measurements, employing cycling voltammetry and linear sweep voltammetry were conducted in a three-electrode cell with a rotating disk electrode (RDE). H_{upd} desorption and iridium-oxide pseudo-capacitance peaks were employed for ECSA measurements. Mass activity (MA) and specific activity (SA) were determined at 1.55V vs RHE after iR correction. Characterization of the catalyst's composition was accomplished through SEM-EDS, while the nanostructure was elucidated using STEM-EDS mapping.

Comparative analysis revealed that the synthesized catalysts exhibited nearly twice the MA and comparable SA for the Oxygen Evolution Reaction (OER) when compared to commercially available Ir-based catalysts. This study sheds light on the potential of Au-Ir bimetallic nanoparticles as efficient and cost-effective electrocatalysts for OER applications.



A representative STEM-EDS mapping of a Au_{core}-Ir_{shell} nanoparticle



OER polarization curves of commercial Ir black and commercial Ir-oxide catalysts and the synthesized Au_{core}-Ir_{shell} catalysts normalized by wt% of Ir in the catalyst.