Synthesis and Characterization of Highly Active IrO_x-Ir Nanoparticles for Oxygen Evolution Reaction in Acid Media

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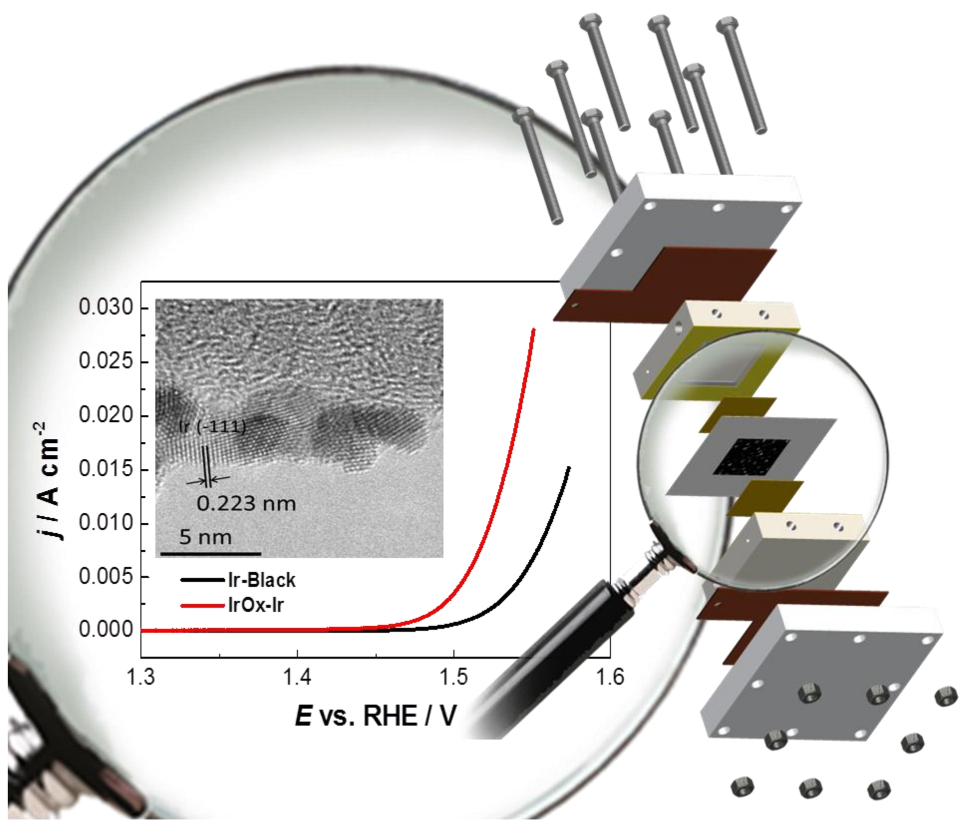


Introduction

For the water splitting in PEM electrolyzers the choice of the oxygen evolution reaction (OER) catalyst employed at the anode has a profound impact on costs, lifetime, and efficiency of the device.[1;2] We have developed a highly active and stable nanostructured Ir catalyst for (OER) in acidic medium, synthesized by an environmental friendly, water free synthesis at room temperature.[3]

Synthesis

- Room temperature
- Waterfree
- Upscalable
- Cheep production

Dry ethanol + **$NaBH_4$**

↓

Mixing solution: Dry ethanol + **$IrCl_3$** + CTAB

↓

Reduction to **IrO_x-Ir**

Method

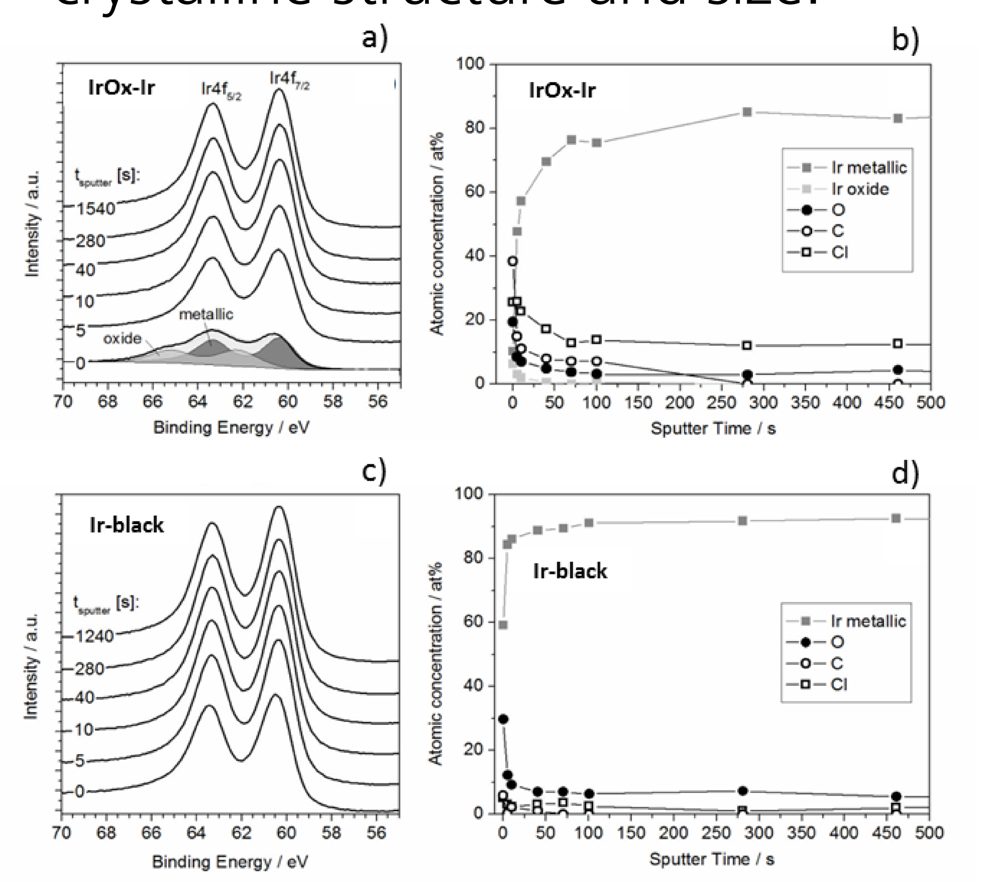
All measurements were done for IrO_x-Ir and Ir-black from Umicore, the most active, commercially available OER catalyst. IrO_x-Ir shows an up to fife-fold higher current density at an overpotential of 250mV, measured on an RDE at 25°C in Ar-saturated 0.5 M. H_2SO_4 solution.

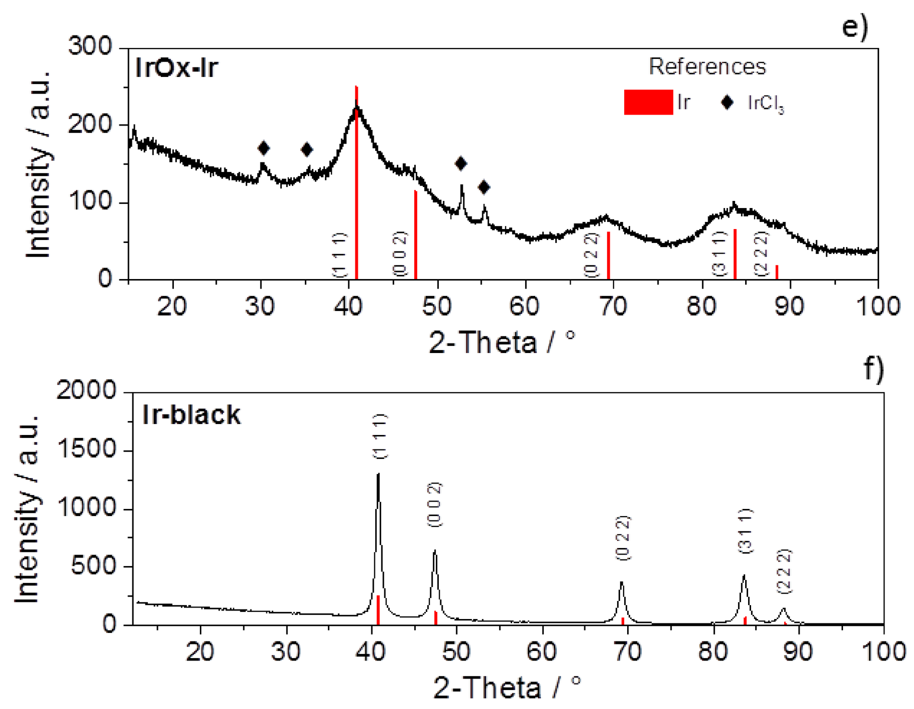
XPS

- highly metallic materials
- thin layer of oxide

XRD

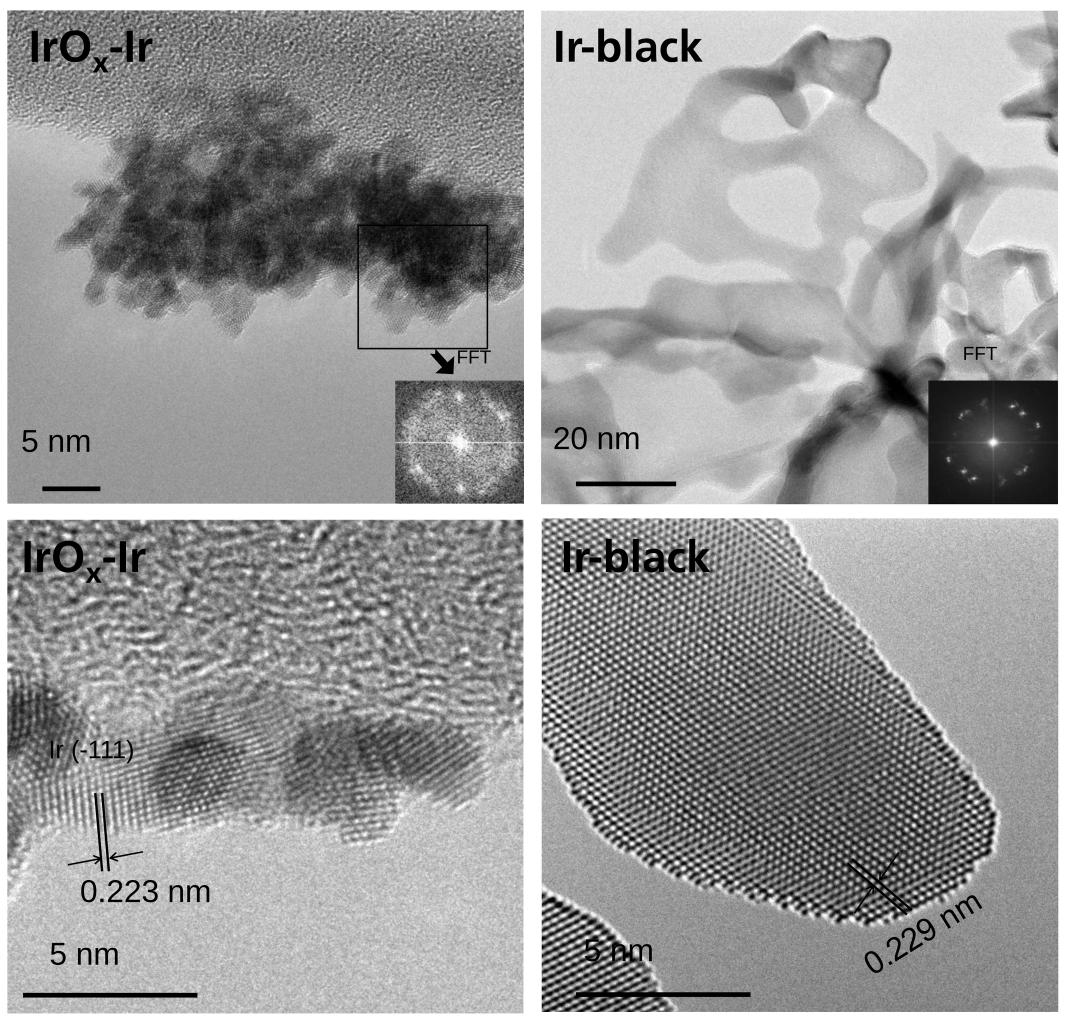
- crystalline structure and size.





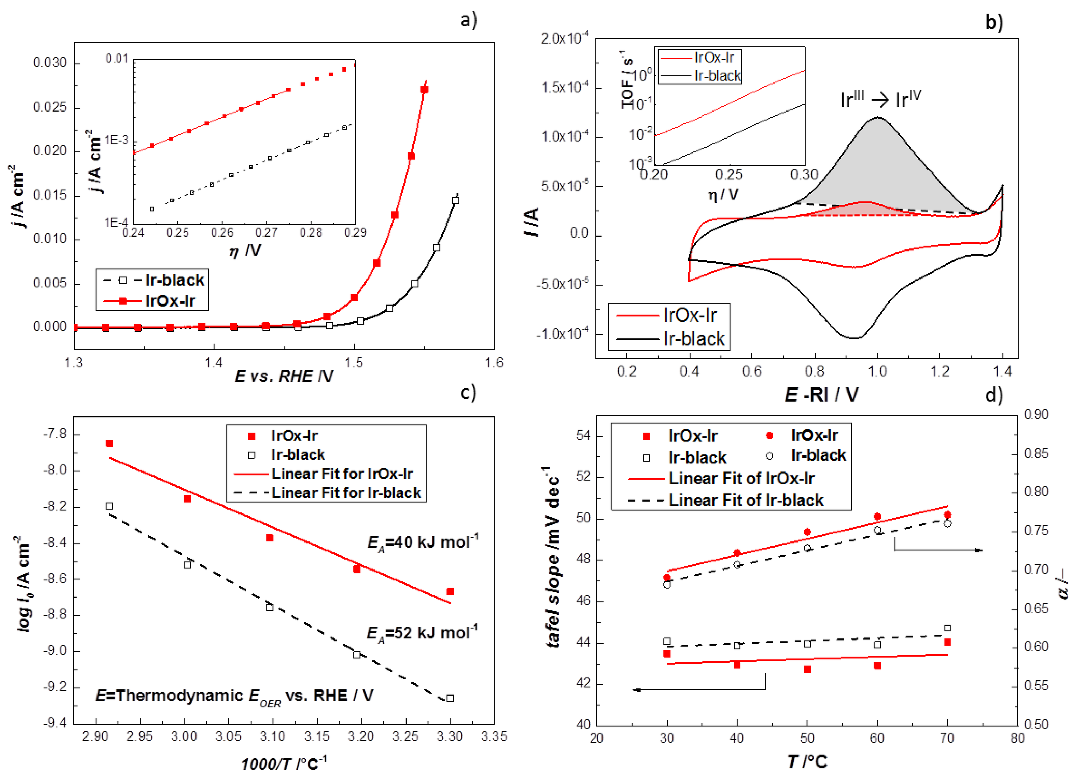
Transmission electron microscopy

- Particle size: 2nm
- High surface area:
  - BET IrO_x-Ir: 60 m² g^{-1}
  - BET Ir-black: 18 m² g^{-1}
- Similar christallin structure



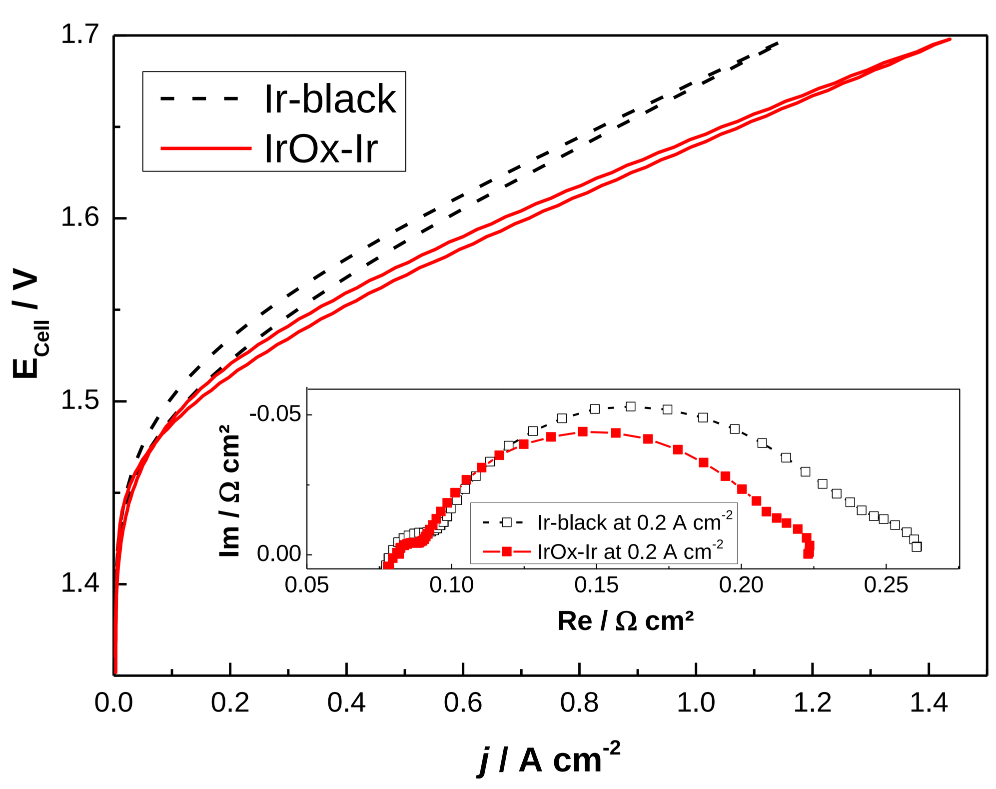
Electrochemical characterization

- High exchange current density
- Fife fold higher activity in A g^{-1}
- 6.8 time less active sites
- 13 time higher activity in A $mmol^{-1}$



PEM electrolyzer test

A MEA with 1mg catalyst loading on the Anode site was produced on Nafion 212 by wet spraying and performed in a PEM electrolyzer test stand of 25 cm² active area, combined with EIS measurements as an in situ characterization method. The catalyst is stable for more than 100h and shows stable performance up to 4 A cm⁻².



Acknowledgements

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[1] Carmo et al. 2013 [2] Marshall et al. 2007 [3] submitted for publication

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