Improving the Performance of Hybrid Photoanodes for Water Splitting by Photodeposition of Iridium Oxide Nanoparticles

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Supporting Information

Experimental:

Scanning electron microscopy (SEM) and Energy-dispersive X-ray spectroscopy (EDX) investigations were performed using FEI ESEM Dual Beam™ Quanta 3D FEG with EDAX Genesis XM2i system.

UV-VIS spectra were recorded using Agilent Technologies Cary 60 UV-Vis Spectrophotometer.

Transmissions electron microscopy (TEM) investigations were performed using a FEI Tecnai F20 G2 TEM (Hillsboro, OR) operating at an acceleration voltage of 200 kV either in bright-field (BF) mode or in scanning mode (STEM) using a high-angle annular dark-field (HAADF) detector.

Solubility of oxygen in different electrolytes:

In order to rule out any "salting-out effect" when discussing Figure 7, we measured the oxygen concentrations in air-saturated solutions of all electrolytes. The solubilities of dioxygen in different electrolytes at pH 5.9 (determined out of 14 measurements) were as follows:

phosphate buffer (0.1 M): 252.4 ± 0.3 μmol dm^{-3}

Na_2SO_4 (0.1 M): 243.8 ± 1.6 μmol dm^{-3}

$LiClO_4$ (0.1 M): 243.3 ± 0.7 μmol dm^{-3}

One can see that the differences in oxygen solubility are negligible. Moreover, the highest solubility was observed precisely for the phosphate buffer solution which has shown the lowest oxygen production rate in Figure 7a. This confirms that the strong effect of the electrolyte composition on the efficiency of oxygen evolution cannot be attributed to a "salting-out effect".

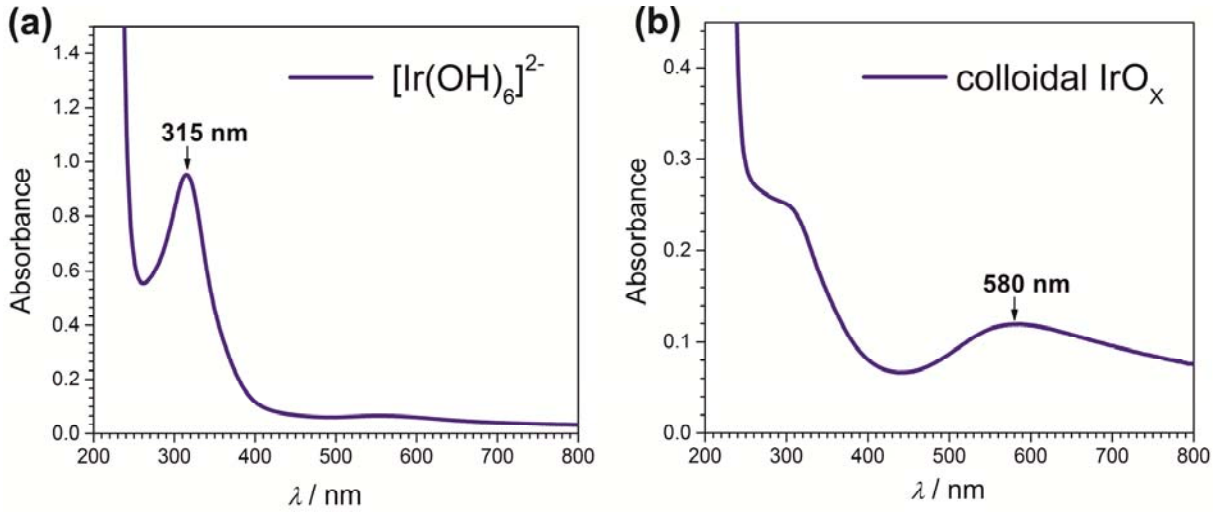

Figure S1: UV-VIS spectra of (a) as-synthesized $[Ir(OH)_6]^{2-}$ precursor solution used for photodeposition and (b) colloidal solution of IrO_x nanoparticles used for colloidal deposition of IrO_x co-catalyst.

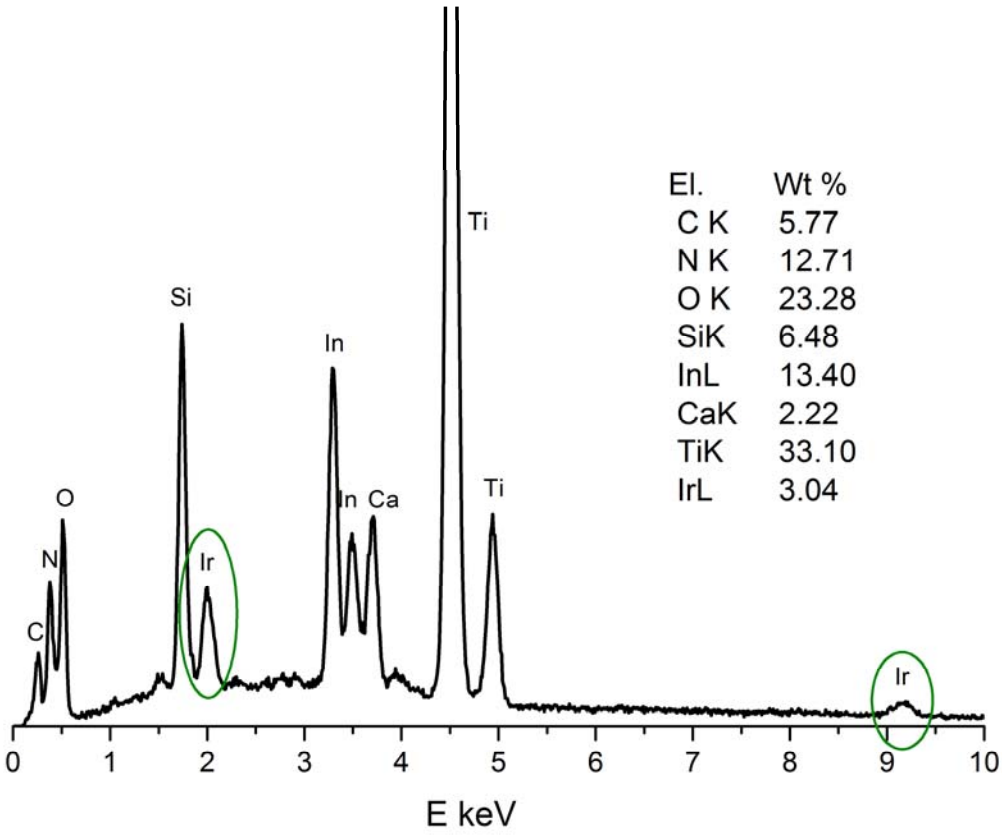

Figure S2: EDX analysis of TiO_2-PH + IrO_x/PD photoelectrode performed on a representative (i.e. larger than the area shown in SEM micrographs) spot with an average distribution of co-catalyst particles. The Ir content amounts to 3.9 wt.% (after correcting for Si, In, Ca amount)

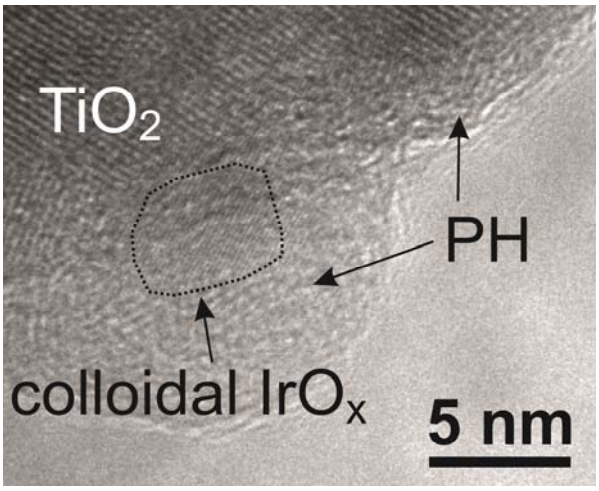

Figure S3: TEM micrograph of powder scratched off from a TiO_2-PH photoelectrode with an IrO_x co-catalyst loaded by colloidal deposition.