# Electroless deposited $IrO_x$ nanoparticles for Ni foam functionalization with low iridium loading

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The generation of Hydrogen by electrolysis using the solar energy is a promising strategy that can pave the way to a sustainable energy economy [1]. However, to date it needs to be improved in terms of efficiency and durability to become appealing. A crucial factor is represented by the electrode and catalyst materials. Among the catalyst, $IrO_2$ represents the best compromise for an active and stable oxygen evolution reaction, however it is precious and rare and an affordable technique consists in depositing a thin layer on the surface of a less noble metal, such as nickel or steel. The deposition of $IrO_2$ usually requires high temperature (200-1000°C), high purity precursors and complex experimental set up. In this paper we propose the use of spontaneous galvanic displacement followed by thermal annealing in air, as a promising and simple deposition technique to cover nickel foam electrodes (figure 1) with $IrO_2$. The experimental conditions have been optimized in order to improve the catalytic activity during water splitting measurements in 1M KOH. Scanning Electron Microscopy (SEM) analyses, coupled with X-ray Energy Dispersive Spectroscopy (EDX) and X-Rays Photoelectron Spectroscopy (XPS) show that, under proper deposition conditions, we can overcome the limits of other deposition techniques, achieving a uniform $IrO_2$ coverage throughout the 3D structure of the Ni foam. Such a condition is crucial for the long term stability of the electrodes under constant current stress [2]. The amount of Ir on the Ni foam has been experimentally evaluated, obtaining optimal results with 8 μg $cm^{-2}$ of noble metal in a 0.16 cm thick electrode. Such a value is more than two orders of magnitude lower than typical values employed in the PEM electrolyzers, therefore making the present approach very promising.

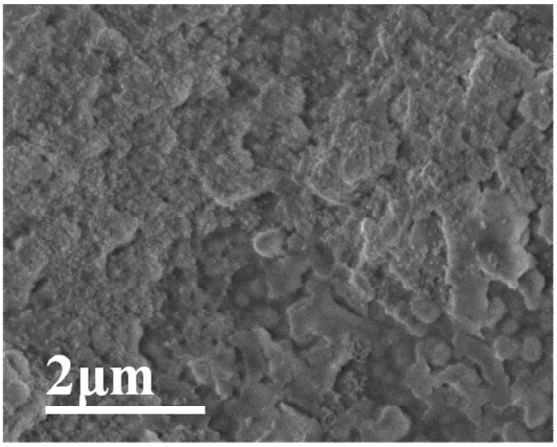


Fig 1: $IrO_2$ particles on Ni foam.

[1] J. Jia et al. Nature Communications 7, 13237 (2016)

[2] R. G. Milazzo et al, International Journal of Hydrogen Energy, 43, (2018), 7903-7910.