Inverted **RDE for True OER Catalyst Degradation Assessment**

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Currently, significant efforts are taken to find the most active and stable electrochemical oxygen evolution reaction (OER) catalyst diverting from critical raw materials. However, to be able to characterize the performance of these new catalysts, it is also needed to consider using the adequate screening methods. It has been recently demonstrated that the conventional rotating disk electrode (RDE)-based studies are not suitable for gas evolving processes due to bubbles uncontrollably blocking catalytic active sites. [1] To overcome this issue, an upward facing configuration of the instrument allows the formed gaseous product to escape the catalyst surface as demonstrated among others for metal deposition and CO_2 reduction reaction. [2,3] Therefore, the true catalyst performance can be screened and assessed. In the current work, we used this so-called *inverted* RDE (*i*RDE) for the OER with Ir nanoparticles supported on commercially available Sb-doped SnO_2 (Ir/ATO). The test consisted in cycling the potential between 1.2 and 1.7 V vs RHE at rate of 10 mV s^{-1}. The evolution of the current densities at 1.5 V vs RHE over the number of cycles obtained with the *i*RDE is compared to the one obtained with the conventional RDE setup (Fig. 1a). Rapid decline of the catalyst activity was observed in the RDE setup, while the catalyst activity demonstrates a rather stable behavior in the *i*RDE setup. The fast activity drop observed in the RDE setup is to some extent due to accumulation of O_2 bubbles on active sites. However, the main reason for catalyst deactivation is the gradual passivation of the catalyst back contact. [4] This latter issue can be overcome by employing a non-porous catalyst that prevents contact between back contact material and electrolyte. Moreover, the oscillations observed in the *i*RDE are accounted for short live bubble retention and detachment as depicted in Fig. 1b-c.

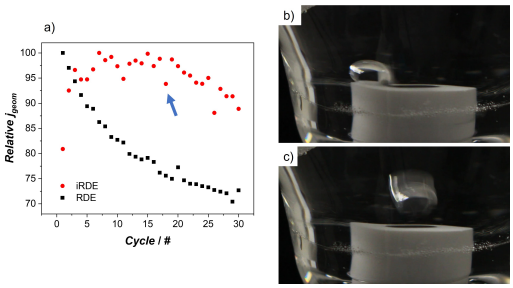

Figure 1. (a) Evolution of the relative current densities at 1.5 V vs RHE over the number of cycles employing the *i*RDE (red) and the RDE (black) setup. (b-c) Photographs of O_2 bubble detachment from Ir/ATO at cycle 18 (blue arrow).

[1] H. A. El-Sayed et al., *J. Electrochem. S.*, **2019**, 166 (8), F458-F464.
[2] P. Moreno-García et al., *Anal. Chem.,* **2020***,* 92, 4301-4308.
[3] P. Moreno-García et al., *J. Electrochem. S.*, **2020**, 167, 042503.
[4] S. Geiger et al., *ChemSusChem*, **2017**, 10, 4140-4143.