High-Throughput Synthesis and Electrochemical Screening of $Ir_{1-x}Co_xO_y$ Electrocatalyst Libraries for Acidic Oxygen Evolution Reaction

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The escalating global demand for renewable energy technologies drives the need to design novel materials for energy storage applications. Proton Exchange Membrane Water Electrolysis (PEMWE), a leading technology for commercialized WE, is still facing challenges due to the choice of used materials. The reliance on Ir-based electrocatalysts for the oxygen evolution reaction (OER) is one of the factors limiting the technology upscaling due to the material scarcity and price.[1] The extensive search for alternative PEMWE electrocatalysts can be facilitated through the implementation of high-throughput (HT) experimentation methods.

The key steps in HT experimental workflows for electrocatalyst development consist of HT synthesis, characterization (structural and performance screening), and data analysis.[2] HT electrochemical activity and stability screening can be effectively performed with scanning flow cells (SFCs) coupled to downstream electrolyte analytics, such as inductively coupled plasma mass spectrometry (ICP-MS) for *operando* dissolution studies. HT synthesis by drop-casting with an automated robotic liquid handler is a method to produce discrete material libraries suitable for HT screening with the SFC-ICP-MS setup. This synthesis method, however, faces some challenges regarding spot quality, reproducibility, shape and size control. In this work, these issues were addressed by automated patterning of the electrode surface with an agarose hydrogel prior to ink drop-casting and optimizing the various ink formulations, yielding good quality reproducible spots for a composition spread of Ir and Co mixed-metal-oxides. Laser microscopy served as a rapid synthesis quality control measure. HT OER activity and stability screening of the $Ir_{1-x}Co_xO_y$ composition spread was performed using the SFC-ICP-MS setup in one day. The proposed HT pipeline (Figure 1) demonstrates a framework for accelerated electrocatalyst development. The potential to partially substitute Ir in IrO_x acidic OER electrocatalysts with the more abundant and non-noble Co up to 60 at.-% without compromising OER activity and Ir dissolution to a large extent was identified.

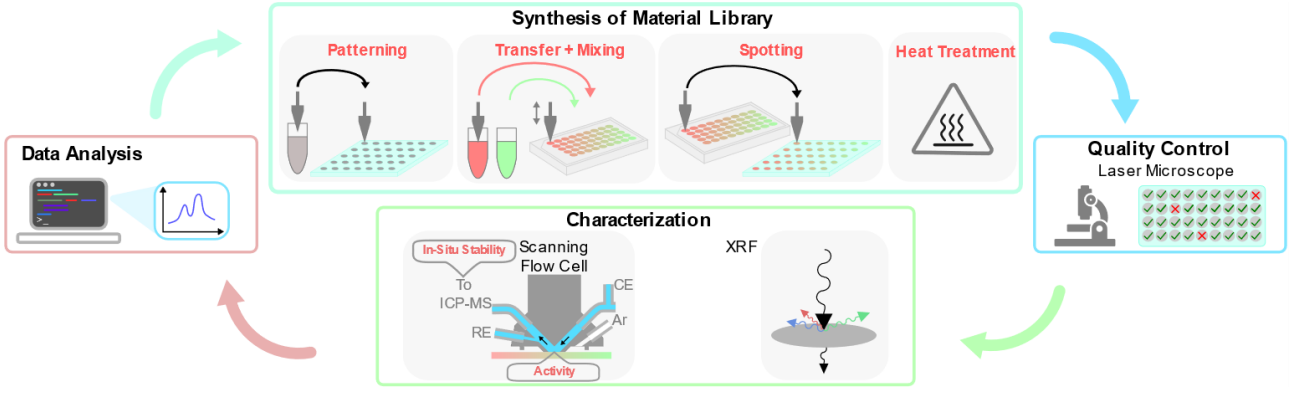

Figure 1: Schematic representation of the HT workflow. Adapted from reference.[2]

References

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