

DEGRADATION AND PERFORMANCE OF CATALYTIC LAYERS FOR WATER ELECTROLYSIS

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ABSTRACT

Hydrogen is expected to play an important role in the transition to a net zero emission society that is planned in the upcoming decades [1]. Production of hydrogen by means of water electrolysis is expected to increase significantly to account for the rising demand. There are three main technologies available for low-temperature water electrolysis: classical alkaline water electrolysis (AWE), proton exchange membrane water electrolysis (PEMWE), and anion exchange membrane water electrolysis (AEMWE). All three technologies rely heavily on the use of electrocatalysts to facilitate the electrochemical reactions taking place at the electrodes [2]. The stability of these electrocatalysts is considered one of the major challenges that is limiting a large-scale production of hydrogen from water electrolysis [3].

In recent years, several research groups have implemented an in-line setup of a flow cell and an inductively coupled plasma mass spectrometer (ICP-MS) to study the dissolution processes of electrocatalysts [3]. A similar setup is currently being implemented at NTNU, Gløshaugen, as part of Øyvind Lindgård's PhD project. The setup consists of a micro-electrochemical flow cell whose outlet is connected directly to the inlet of the ICP-MS, as illustrated in Figure 1. The catalyst is coated onto the working electrode (WE) of the flow cell and an external potentiostat is used to expose the catalyst to voltages (or currents) to simulate the water electrolysis process, or to perform other electrochemical characterization methods. Any catalyst that is dissolved during the experiment will be transported in the electrolyte to the ICP-MS for quantification.

The continuous quantification of degradation products means that it is possible to create time-resolved data of the catalyst dissolution process. An experiment typically reported in literature consists of sweeping the potential at the WE (cyclic voltammetry (CV)) and continuously detecting the catalyst dissolution products as a function of time [3, 4]. Combining the CV and the catalyst dissolution graphs in the same plot can provide a deep insight into the exact potentials at which dissolution occurs.

At NTNU, this in-line setup of a flow cell and an ICP-MS will be used to evaluate the stability of new electrocatalysts for water electrolysis synthesized at the Department of Material Science and Engineering, as well as further investigating the dissolution process of current electrocatalysts for water electrolysis, such as IrO₂.

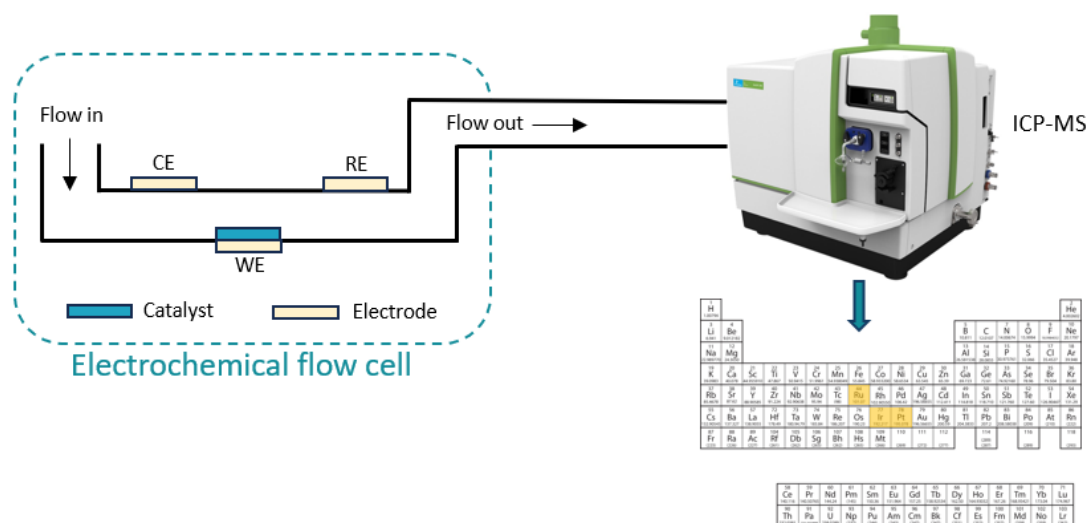


Figure 1 In-line setup of electrochemical flow cell and ICP-MS that will be used to evaluate stability of electrocatalysts for water electrolysis.

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