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Understanding the Structure-Activity Relationship on Ni-based Electrodes used in Alkaline Electrolysis

Keywords: Electrocatalysis, material science, oxygen evolution reaction, hydrogen evolution reaction

Offer description:

The harmful impact of greenhouse gases on the Earth's climate has prompted an intensive search for alternative, environmentally-friendly energy sources. In this context, renewable energies are promising options, but large-scale energy storage systems are needed to remedy their intermittency. Alkaline water electrolyzers (AWEs) are ideal for converting electrical energy from renewable sources into molecular hydrogen (H_2), an energy vector with high energy density and minimal environmental impact. Although AWEs have an existing market and significant investment, this technology still needs to be improved, particularly in terms of lifetime and efficiency. To solve these issues, it is important to gain a fundamental understanding of electrode structure and the structure-activity-stability relationship, in order to improve AWE performance and stability. At ADELE Hydrogen, leveraging over 45 years of cumulative R&D of the cofounders, this start-up has successfully developed PGM-free electrodes that surpass reported performance benchmarks, hence the name ADELE: Advanced Electrodes for Alkaline Electrolysers.

To gain a deeper understanding of these advanced electrodes at a fundamental level and unlock their full potential, it is essential to study their behaviors and characterizations under various conditions. This includes investigating their performance during start-stop operations (reverse current) and assessing changes before and after accelerated stress tests to identify operational limitations. Structural, chemical, and phase changes will be analyzed to evaluate surface deactivation and potential degradation mechanisms.

This master's thesis provides an exciting opportunity to engage in fundamental research on an industrial applied topic. The project will combine bibliographic research, experimental studies, and the development of new methods and tools. Throughout the thesis, the student will acquire valuable skills in applied electrochemistry, energy storage devices, and independent research. This internship also has the potential to lead to a CIFRE thesis in collaboration with ADELE Hydrogen, a dynamic start-up in the hydrogen energy sector.

Location: LEPMI laboratory on Grenoble University campus, FRANCE

Goals:

- Electrochemical characterizations (impedance, cyclic voltammetry, chronoamperometry, etc.)
- Physico-chemical characterizations of fresh and aged Ni-based electrodes (XRD, XPS, BET, SEM, SEM-FIB, TEM, IL-TEM, ICP-MS).
- Data treatment and interpretation
- Writing experimental protocols and reports

Student profile: Background in chemistry and/or material science, familiar with electrochemistry and/or energy storage thematic, as well as basic coding or modelization is a plus.

Duration: 6 months **Starting date:** March 2025

Estimated remuneration: 900 € - 1 000 € per month

To apply to this master thesis please send your CV and motivation letter to Kavita Kumar (kavita.kumar@grenoble-inp.fr) and Huong Doan (huong@adelehydrogen.com).