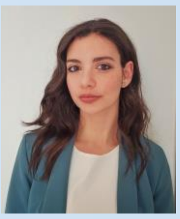
Università degli Studi di Palermo

dipartimento di ingegneria unipa

Fabrication and Characterization of Nanostructured Electrodes for Electrochemical Devices



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Alkaline Electrolyser

Concept

In the quest for mitigating climate change and reducing greenhouse gas emissions, the utilization of renewable energy sources (RES) stands out as a pivotal strategy. One of the significant challenges associated with renewable energy lies in its inherent unpredictability. In this perspective, green hydrogen emerges as a promising candidate as effective energy storage system. Green hydrogen is produced through the electrolysis of water using RES. Despite its remarkable attributes, including zero emissions during utilization, green hydrogen still grapples with economic viability hurdles. Its production entails substantial costs, primarily driven by the expenses associated with materials and electricity. Another impediment to the production of green hydrogen concerns the necessity of deionized water. Seawater can be a promising alternative electrolyte for industrial hydrogen production. Although water electrolyzer (WE) is a mature technology, many efforts are still being made to improve its performance and reduce the cost of production, using low-cost, stable, and selective electrodes made of noble-metal-free electrocatalyst.

Scientific approach

The development of cheap electrodes with high electrocatalytic features is one of the potential approaches to increase the WE performance. This research project is focused on improving the Seawater Electrolysis and reducing the cost of hydrogen produced throughout the development of Nickel-based nanostructured electrodes. Ni based nanostructured electrodes provides many electrocatalytically active sites, facilitates the electrolyte mass transport and the release of gas bubbles. Nickel was selected as the base material thanks to its low cost and high chemical stability in alkaline. To improve Ni performance, Ni alloys with different metals have been investigated. Among the transition metals, the iron group elements are the most used. These alloys were selected due to their very promising properties. After the fabrication process, electrodes were characterized from different points of view, chemically and electrochemically, to study morphology, composition and electrocatalytic performance. The aim is to obtain the most suitable alloy for Hydrogen Evolution Reaction (HER) and Oxygen Evolution Reaction (OER).

Research objectives

Many challenges make the industrial application seawater splitting of difficult. Seawater is rich in various electrochemically active ions, like chlorine ions. These species will directly interact at the anode during seawater electrolysis and to compete with OER. In addition, chlorine ions could severely corrode the electrode. Thereby, the direct seawater electrolysis needs selective and robust electrocatalysts with improved activity and stability to reduce production costs and that can prevent the interference of competing reactions.