Novel Catalysts for Water Splitting Reaction in Alkaline Electrolyser

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To meet the climate objectives outlined by the European Union (including Fit For55 and The Green Deal Industrial Plan), it is imperative to boost the proportion of renewable energy sources. In instances of abundant capacity, surplus energy from wind and solar farms must be effectively stored. One promising solution for this task is the utilisation of alkaline electrolysers (AELs), which generate hydrogen as an energy carrier. However, the cost of AELs and the hydrogen they generate remains high due to the presence of precious metals in their electrodes. To mitigate this issue, there is a need to employ cost-effective materials and electrode manufacturing techniques to drive down the overall price.

Previously, inexpensive Ni-network electrodes have been tested in AEL, but their efficiency has not yet been sufficiently good for practical applications. The solution to the problem is using high surface area porous catalysts, including nickel foam catalysts, which literature data indicate are very active and stable.[1] Therefore, catalysts based on nickel foam deposited on nickel mesh (Figure 1) are being developed. The nickel foam is modified with catalytically active FeOOH centres for the anode catalyst to achieve oxygen evolution reaction (OER) activity.[2] Highly porous nickel foams alloyed with transition metals (Fe, Co, Mn) were prepared using the dynamic hydrogen bubble templating method.[3,4] Electrochemical screening experiments in 1 M KOH electrolyte revealed that alloying with Fe, especially in the presence of Fe^{3+} ions, resulted in overall high activity and low overpotential toward OER. Moreover, the ratio of Fe to Ni was crucial to obtain highly active catalysts.

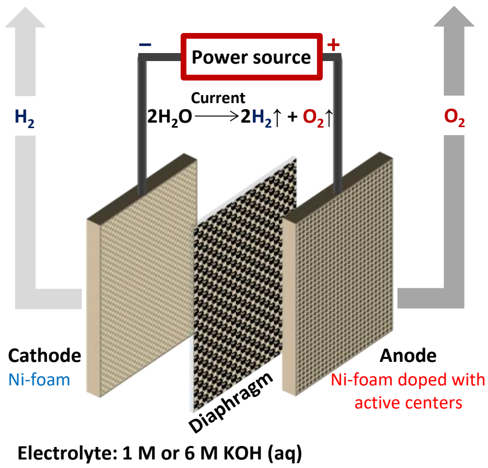

Figure 1. Alkaline electrolyser with designed electrodes.

In order to enhance the effectiveness of AELs, it's also essential to employ the most efficient and straightforward electrode fabrication methods available. Simultaneously, these techniques should be scalable and automated, allowing for easy ramping up of AEL production volumes in response to increasing demand. Furthermore, advanced electrode fabrication technology plays a crucial role in prolonging the lifespan of AELs. With this objective in mind, a hypothesis emerges: the utilization of an ultrasonic spraying system for electrode production enables the implementation of a scalable and straightforward manufacturing approach for synthesized electrode materials, capable of producing electrodes up to m^2 in size. According to the proposed hypothesis, electrodes have been prepared using different ionomers and coating conditions to prepare the suspension used in the spray system.

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