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NiFe-Type Catalysts for Anion Exchange Membrane (AEM) Electrolyzers

Authors : Boldin Roman, Liliana Analía Diaz

Abstract : As the hydrogen economy continues to expand, reducing energy consumption and emissions while stimulating economic growth, the development of efficient and cost-effective hydrogen production technologies is critical. Among various methods, anion exchange membrane (AEM) water electrolysis stands out due to its potential for using non-noble metal catalysts. The exploration and enhancement of non-noble metal catalysts, such as NiFe-type catalysts, are pivotal for the advancement of AEM technology, ensuring its commercial viability and environmental sustainability. NiFe-type catalysts were synthesized through electrodeposition and characterized both electrochemically and physico-chemically. Various supports, including Ni foam and Ni mesh, were used as porous transport layers (PTLs) to evaluate the effective catalyst thickness and the influence of the PTL in a 5 cm^2 AEM electrolyzer. This methodological approach allows for a detailed assessment of catalyst performance under operational conditions typical of industrial hydrogen production. The study revealed that electrodeposited non-noble multi-metallic catalysts maintain stable performance as anodes in AEM water electrolysis. NiFe-type catalysts demonstrated superior activity, with the NiFeCoP alloy outperforming others by delivering the lowest overpotential and the highest current density. Furthermore, the use of different PTLs showed significant effects on the electrochemical behavior of the catalysts, indicating that PTL selection is crucial for optimizing performance and efficiency in AEM electrolyzers. Conclusion: The research underscores the potential of non-noble metal catalysts in enhancing efficiency and reducing the costs of AEM electrolysers. The findings highlight the importance of catalyst and PTL optimization in developing scalable and economically viable hydrogen production technologies. Continued innovation in this area is essential for supporting the growth of the hydrogen economy and achieving sustainable energy solutions.

Keywords : AEMWE, electrocatalyst, hydrogen production, water electrolysis.
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