**Recycled Polymer Derivatives Used As Electrocatalysts for Enhanced Electrocatalytic Activity in Alkaline Water Electrolysis**

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**Abstract Text:**

Advanced alkaline water electrolysis is considered one of the most promising technologies for enabling the large-scale production of green hydrogen powered by renewable energy sources. Despite the increasing complexity of assembling industrial-scale electrolyzer plants, the fundamental working principle remains consistent—two half-cells consisting of anode and cathode sites, where the oxygen evolution reaction (OER) and hydrogen evolution reaction (HER) occur, respectively. Noble metals like platinum (Pt) have been extensively utilized as electrocatalysts because of their superior catalytic performance. However, their high cost and limited availability pose significant challenges for large-scale hydrogen production. As a result, researchers are increasingly shifting their focus towards non-precious metal-based catalysts, which offer a more economically viable alternative.

In this study, we synthesized electrocatalysts using recycled polymer materials, including technology-derived sponges and polyurethane (PU) sponges. These sponges contain nitrogen-rich components, which are nitrogen sources capable of chelating with metal ions and forming metal-nitrogen functionalities. These metal-nitrogen functional groups play an important role in enhancing the electrocatalytic activity of the materials for alkaline water electrolysis. The structural advantages provided by these functionalities promote improved catalytic performance by optimizing the interaction between the catalyst and the reactive species involved in OER and HER.

This work reports the synthesis and complex formation using recycled melamine and PU sponges combined with metal precursors, specifically iron, copper, and molybdenum. These complexes were thoroughly characterized to understand their catalytic properties and potential application in alkaline water electrolysis.The LSV results in the figure prove that the OER activity of electrocatalysts prepared from MS and PU is better than that of RuO2. Our results indicate that recycled polymer derivatives can serve as effective, sustainable precursors for synthesizing electrocatalysts, thus contributing to cost-effective and environmentally friendly hydrogen production technologies.

