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Electrocatalytic Activity of Carbon-supported PdFe Nanoparticles Towards the Ethanol Oxidation in Alkaline Media

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The electro-oxidation of ethanol is a topic of significant importance due to its relevance as a renewable biofuel and application in fuel cells. Ethanol is particularly attractive because it can be produced sustainably from biomass and is less toxic compared to methanol. However, the complete oxidation of ethanol to CO₂, which releases 12 electrons, is challenging with conventional noble metal catalysts like platinum. These catalysts often suffer from poisoning by carbonaceous intermediates such as CO and CH_x species, which adsorb strongly on the catalyst surface, thus reducing their efficiency and durability. The need for catalysts that can effectively break the C-C bond and fully oxidize ethanol to CO₂ has driven research towards alloying noble metals with other elements to enhance their catalytic properties. This study focuses on the comparative study of the electrochemical activity of Pd/C and PdFe/C nanoparticles towards the oxidation of ethanol in alkaline media. The nanoparticles were evaluated using cyclic voltammetry (CV) and Tafel analysis to assess the catalytic performance and kinetic parameters. So far, our findings indicate that PdFe/C nanoparticles exhibit superior catalytic activity compared to Pd/C nanoparticles. The CV profiles reveal that the PdFe/C catalysts have a higher peak current density and lower onset potential for ethanol oxidation, suggesting enhanced electrocatalytic properties. The Tafel plots corroborate these results, indicating improved reaction kinetics. The addition of Fe to Pd appears to facilitate the cleavage of the C-C bond in ethanol, promoting the complete oxidation to CO₂ and mitigating catalyst poisoning by intermediates. This study contributes to the understanding of bimetallic catalysts' role in enhancing the activity and stability of the ethanol electro-oxidation reaction.

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