Fe–Co Dual-Atom Defect-Engineered 2D Graphene for Oxygen reduction Reaction

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Abstract

The design of non-precious metal electrocatalysts with high activity and stability for the oxygen reduction reaction (ORR) is crucial for the development of next-generation energy conversion devices. Herein, we present a defect-engineered two-dimensional graphene electrocatalyst with atomically dispersed Fe-Co dual-atom active sites. Defect engineering is carefully designed to provide a high density of anchoring sites for the adjacent Fe and Co atoms, facilitating strong metal-metal interactions. Advanced structural analyses demonstrate the successful creation of Fe-Co dual atoms uniformly dispersed in the defect-rich graphene matrix, while the modulation of the electronic structure due to metal-metal interactions promotes charge redistribution at the active sites. The electrochemical analysis reveals highly efficient ORR performance in an alkaline medium, marked by a high onset potential, desirable half-wave potential, close to four-electron transfer process, and excellent durability. The catalyst also displays high resistance to methanol crossover, emphasizing its potential use. The improved ORR performance is ascribed to the synergistic effect of Fe and Co dual atoms, the defect-induced electronic structure modulation of graphene, and the high conductivity and high surface area of the 2D material.

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