Atomically Dispersed Cerium Sites on Carbon Supports for Electrochemical CO_2 Reduction

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ABSTRACT

Carbon dioxide (CO_2) is a key greenhouse gas driving climate change. Its rise comes from burning fossil fuels and human activities. It's vital to find effective solutions to reduce CO_2 in the atmosphere. We can expand the use of renewable energy and integrate it with electrochemical CO_2 reduction reactions to establish an efficient and sustainable energy cycle.

Electrochemical CO_2 reduction reaction (EC-CO_2RR) is a promising method to convert CO_2 into valuable chemicals and fuels using electrical energy. By applying a suitable potential, electrocatalysts activate CO_2 and produce compounds such as formate, methanol, or hydrocarbons. The reaction occurs at the cathode, while water oxidation at the anode supplies protons and electrons. When coupled with renewable energy, EC-CO_2RR offers a carbon-neutral route to store electricity and reduce emissions, supporting a more sustainable energy cycle.

Cerium is the most abundant rare earth element on Earth[1], in previous studies have shown that cerium oxides, when combined with other metals in electrochemical carbon dioxide catalysis[2,3], can improve the stability of materials. However, there have been rare reports on how cerium behaves in electrochemical carbon dioxide reduction reactions. Therefore, future research aims to conduct electrochemical studies on cerium and its derivatives, and to combine them with carbon substrates to improve their conductivity. Simultaneously, efforts will be made to synthesize cerium single-atom catalysts to further investigate the relationship between the 4f orbital, electron transport, and the electrochemical reaction of carbon dioxide.

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