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ABSTRACT:

High-Entropy Oxide Rock Salt Catalyst for High-Performance Solid Oxide Fuel Cells

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Solid oxide fuel cells (SOFCs) are among the most efficient electrochemical technologies for clean energy conversion; however, their widespread deployment is limited by sluggish electrode kinetics and inadequate redox stability at reduced operating temperatures. High-entropy oxides (HEOs) provide a transformative materials platform by combining configurational entropy with multicomponent chemistry to create highly active and structurally robust catalytic surfaces. Here, we present a Li-doped (CoCuMgZnNi)O HEO as a bifunctional redox catalyst for SOFC electrodes. The entropy-stabilized framework generates severe lattice distortion, abundant oxygen vacancies, and optimized electronic structure, while alkali-metal modulation enhances lattice-oxygen mobility and mixed ionic/electronic conductivity. These synergistic effects promote rapid hydrogen oxidation and oxygen reduction through a reversible lattice-oxygen redox mechanism, enabling accelerated oxygen exchange, efficient charge transfer, and reduced polarization resistance. The catalyst also exhibits excellent structural integrity and electrochemical durability under repeated redox cycling. This presentation will discuss the fundamental relationship between entropy engineering, defect chemistry, and reversible redox catalysis, demonstrating how HEO can redefine the design of next-generation SOFC electrocatalysts for efficient and durable energy conversion.

Keywords: High-entropy oxide, redox catalysis, SOFC, lattice oxygen, oxygen vacancies, bifunctional electrocatalyst.