Developing efficient anode catalysts for direct ammonia solid oxide fuel cells

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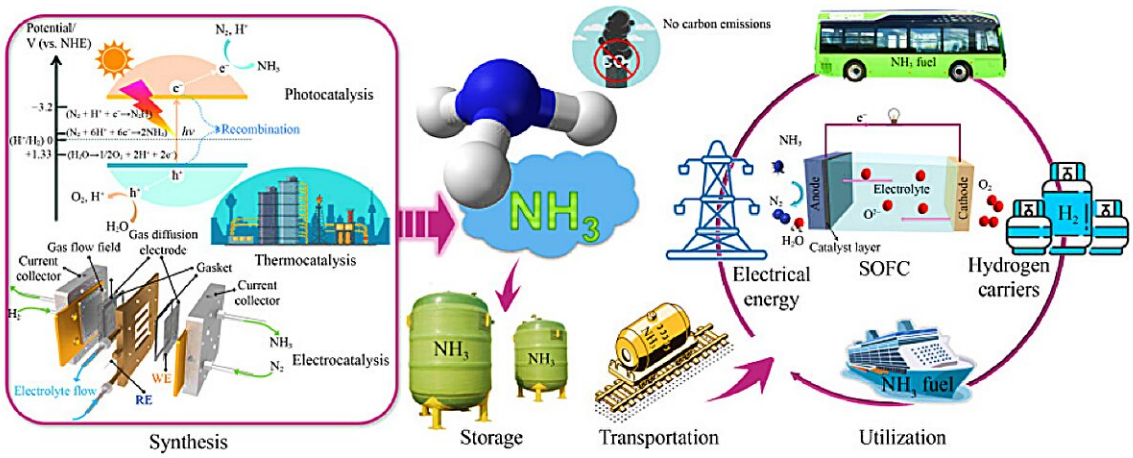

Synthesis and utilization of green ammonia. Credit: *Frontiers in Energy* (2024). DOI: 10.1007/s11708-024-0948-2

The quest for efficient and clean energy sources has led to the exploration of ammonia as a hydrogen carrier due to its high hydrogen content, energy density, and ease of liquefaction. Solid oxide fuel cells (SOFCs) are highly efficient electrochemical devices that can utilize fuels like hydrogen and hydrocarbons. However, the storage and transportation of hydrogen pose significant challenges due to its low bulk density and boiling point.

Ammonia-based SOFCs offer a promising alternative, and optimizing their performance at intermediate temperatures is a key area of interest.

A research group led by Fulan Zhong and Yu Luo from Fuzhou University focused on the development of pyrochlore $La_2Zr_{2-x}Ni_xO_{7+\delta}$ (LZN_x) oxides as anode catalysts for NH_3-SOFCs.

The team investigated the effects of Ni^{2+} doping on the crystal structure, surface morphology, thermal matching with Yttria-stabilized zirconia (YSZ), conductivity, and electrochemical performance of these oxides.

The study is published in *Frontiers in Energy*.

The LZN_x oxides were found to exhibit n-type semiconductor behavior with excellent high-temperature chemical compatibility and thermal matching with the YSZ electrolyte. Additionally, $LZN_{0.05}$ demonstrated the smallest conductive band potential and bandgap, leading to a higher power density as anode material for NH_3-SOFCs.

The $LZN_{0.05}$-40YSZ composite anode achieved a maximum power density of 100.86 mW/cm^2 at 800 °C, which is 1.8 times greater than that of NiO-based NH_3-SOFCs under identical conditions. Moreover, the $LZN_{0.05}$-40YSZ composite anode showed negligible voltage degradation after continuous operation at 800 °C for 100 h, indicating its extended durability.

The development of LZN_x anodes addresses a critical need for efficient anode catalysts in NH_3-SOFCs, offering a significant step forward in the support of the hydrogen economy through ammonia utilization.

The improved conductivity and electrochemical performance, coupled with the demonstrated durability, suggest that these materials could play a pivotal role in the future of clean energy generation.

More information: Shiqing Yang et al, Pyrochlore La2Zr2–xNixO7 anodes for direct ammonia solid oxide fuel cells, *Frontiers in Energy* (2024). DOI: 10.1007/s11708-024-0948-2

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