Developing an eco-friendly ammonia catalyst

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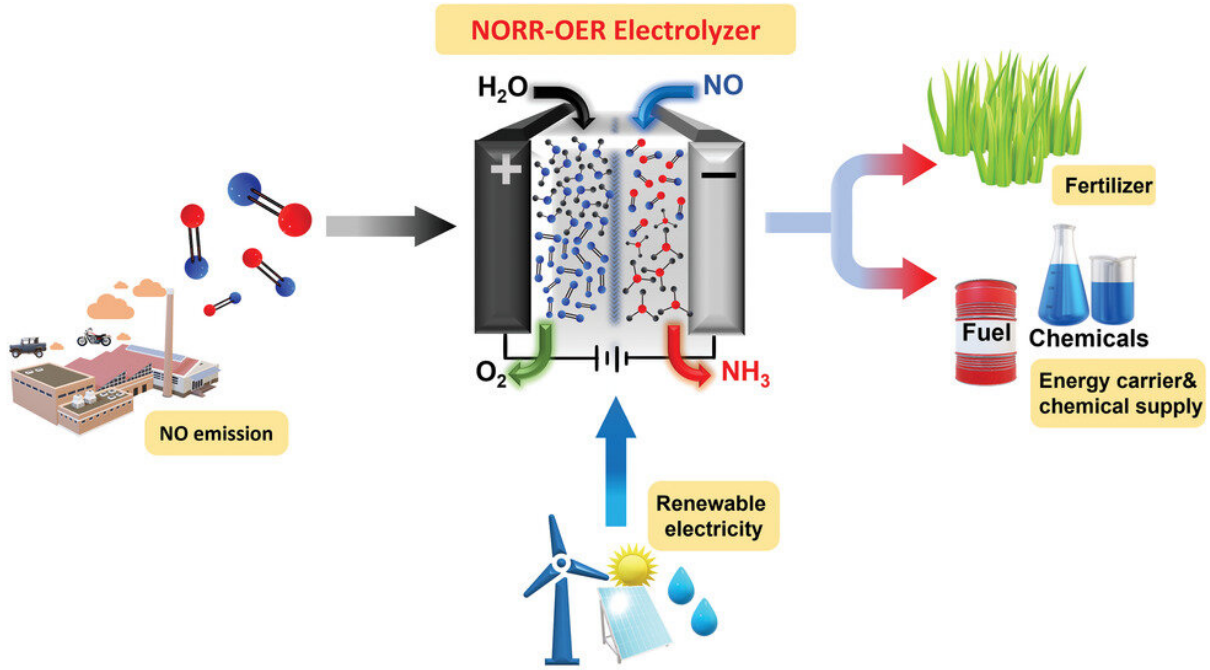

Schematic illustration of the strategies involved in the electroconversion of air pollutant NO to NH_3 via electrolyzer powered by renewable electricity. The produced NH_3 can be used as the feedstock of fertilizers, chemical supply, and energy carriers. Credit: *Advanced Science* (2022). DOI: 10.1002/advs.202201410

A DGIST research team led by Professor Sangaraju Shanmugam, Department of Energy Engineering, developed a catalyst that converts nitric oxide (NO) to ammonia (NH_3). This electrochemical technology offers high Faradaic efficiency and low overpotential and produces NH_3 in an eco-friendly manner.

NH_3 is an important chemical raw material in the fertilizer, textile, and pharmaceutical industries, and it is considered a carbon-free hydrogen carrier with a high energy density. Typically, NH_3 is produced using the Haber–Bosch process; however, this process is responsible for approximately 1–2% of global CO_2 emissions.

The electrochemical conversion of NO to NH_3, an alternative to the Haber–Bosch process, has received considerable attention. This eco-friendly method consumes the air pollutant NO gas to produce NH_3. Therefore, this promising approach can replace conventional methods without affecting the environment or emitting CO_2.

However, owing to the corrosive nature of NO gas, the morphology of the metal-nanoparticle electrocatalyst degrades during electrosynthesis. Therefore, it is necessary to obtain a catalyst material with high stability that facilitates long-term electrochemical NH_3 synthesis.

Professor Shanmugam's research team developed a core-shell nickel nanoparticle coated with nitrogen-doped carbon nanostructured electrocatalysts via a simple co-precipitation method for stable NH_3 production. This catalyst is stable and efficient and offers a high Faradaic efficiency of 72.3% at a low overpotential (550 mV) in a 100% NO-saturated electrolyte.

Additionally, a solar-to-NH_3 efficiency of 1.7% and Faradaic efficiency of more than 50% were achieved using a solar-energy-assisted full-cell PV-NORR electrolyzer.

Professor Shanmugam says that "this research has developed an energy-efficient and eco-friendly technology to synthesize NH_3 with zero carbon footprint, and we hope to commercialize this technology to contribute to environmental conservation and sustainability."

The findings of this research were published in *Advanced Science*.

More information: Sridhar Sethuram Markandaraj et al, Electrochemical Reduction of Nitric Oxide with 1.7% Solar-to-Ammonia Efficiency Over Nanostructured Core-Shell Catalyst at Low Overpotentials, *Advanced Science* (2022). DOI: 10.1002/advs.202201410

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