Electrochemical Hydrogen Production from Ammonia

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Energy and clean technology

> TRL 2-3

Executive statement
An innovative electrolytic cell technology enables efficient hydrogen generation from ammonia at ambient temperature using platinum-based electrodes.

Solution
This technology involves an electrolytic cell comprising a cathode half-cell with water-based catholyte and an anode half-cell containing an ammonia-based anolyte, separated by a semipermeable membrane.

The anode features platinum deposited on an electrically conductive support prepared via pulsed electrodeposition.

Applying a low voltage across the electrodes facilitates ammonia oxidation at the anode and hydrogen evolution at the cathode under mild conditions (room temperature and pressure).

This process offers a low-energy, cost-effective, and environmentally friendly method to generate hydrogen from green ammonia, leveraging existing ammonia infrastructure.

Intellectual Property Status
Provisional application 2025902509

Key advantages
- Hydrogen generation at ambient temperature and pressure, reducing energy consumption and equipment costs.
- High catalytic activity and stability of platinum electrodes, with minimal catalyst deactivation over extended operation (>500 hours).
- Use of pulsed electrodeposition to produce durable, high-performance platinum catalysts on titanium supports.
- Faradaic efficiency for nitrogen formation exceeding 90%, indicating minimal side reactions.
- Compatibility with existing ammonia production and transportation infrastructure.
- Reduced carbon footprint by enabling green hydrogen production without fossil fuel consumption.

Problems solved
- High energy consumption and costly equipment requirements of conventional ammonia cracking methods (thermal and catalytic cracking).
- Catalyst degradation and short lifetime in existing catalytic cracking technologies.
- Complex reactor designs and stringent operating conditions limiting scalability.
- Carbon dioxide emissions associated with fossil fuel-based hydrogen production.
- Storage and transportation challenges of hydrogen gas by using ammonia as a stable hydrogen carrier.

Market applications
- Green hydrogen production for fuel cells and clean energy applications.
- Hydrogen supply for industrial processes requiring low-carbon energy sources.
- Integration into existing ammonia infrastructure to facilitate hydrogen storage and transport.
- Power generation in internal combustion engines and fuel cells using ammonia-derived hydrogen.
- Contribution to carbon neutrality goals and global energy transition initiatives.

Inventors
Dr Fengwang Li, Jualei Huang

Contact Commercialisation Office
Lulu Xue
Commercialisation Manager
Email: lulu.xue@sydney.edu.au
sydney.edu.au/innovation-and-enterprise