Researchers develop chainmail integrated-electrode for highly efficient hydrogen sulfide electrolysis

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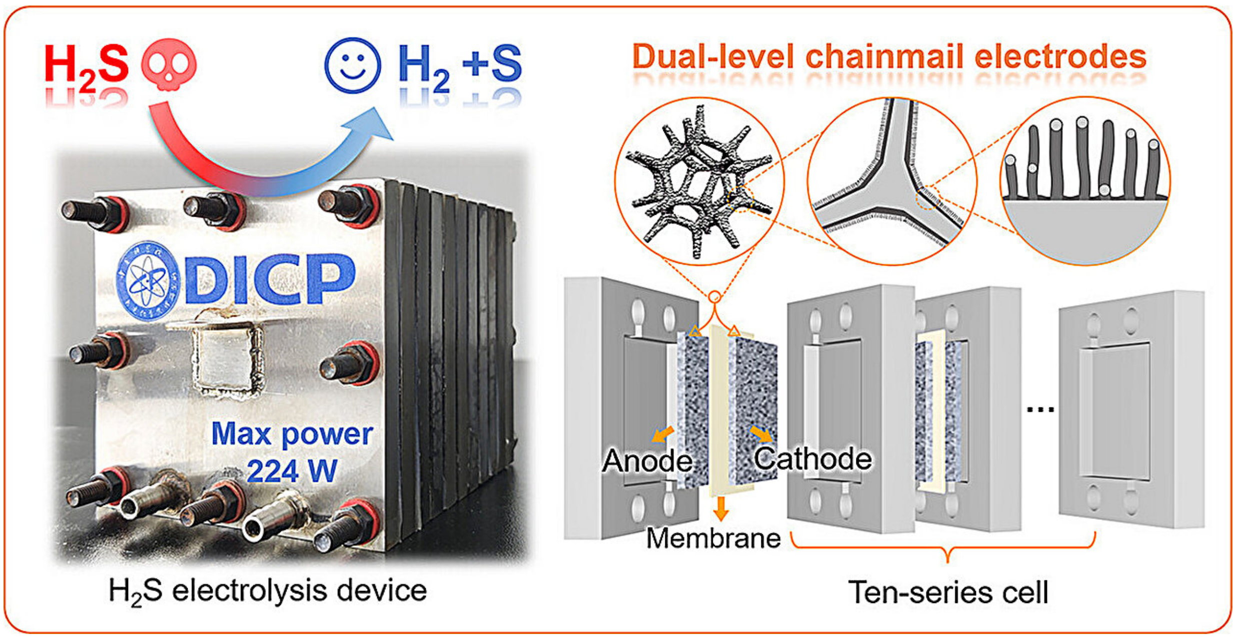

Graphical abstract. Credit: *Angewandte Chemie International Edition* (2025). DOI: 10.1002/anie.202502032

Hydrogen sulfide (H_2S), a toxic and corrosive byproduct of fossil fuel extraction, poses significant environmental and industrial challenges. While the conventional Claus process converts H_2S into elemental sulfur, it fails to recover hydrogen gas, missing an opportunity for sustainable energy production.

Electrocatalytic H_2S decomposition offers a promising strategy to simultaneously eliminating pollutants and producing green hydrogen. However, the acidic nature of H_2S deactivates non-precious metal catalysts and degrades electrode structures, making it difficult to achieve both high efficiency and long-term stability.

In a study published in *Angewandte Chemie International Edition*, a research group led by Prof. Deng Dehui and Assoc. Prof. Cui Xiaoju from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences has developed a dual-level chainmail integrated-electrode that enables highly efficient hydrogen production via H_2S electrolysis.

Researchers designed a graphene encapsulating nickel foam (Ni@NC foam) electrode with a dual-level chainmail structure, enhancing both catalytic activity and durability.

This electrode achieved an industrial-scale current density exceeding 1 A/cm^2 at 1.12 V versus the reversible hydrogen electrode, which is five times higher than commercial nickel foam electrodes. The Ni@NC foam electrode remained stable for over 300 hours, demonstrating a lifespan at least ten times longer than commercial nickel foam electrodes.

In a simulated natural gas desulfurization test, the chainmail integrated-electrode completely oxidized and removed 20% H_2S at the anode, producing sulfur powder simultaneously. Meanwhile, high-purity hydrogen was collected at the cathode. Compared with conventional water electrolysis, the system reduced energy consumption by 43% at the current density of 200 mA/cm^2, offering a more sustainable approach to hydrogen production.

"Our study provides an efficient, low-energy solution for natural gas purification and opens up the potential of converting H_2S into valuable hydrogen fuel for industrial applications," said Prof. Deng.

More information: Mo Zhang et al, Highly Effective and Durable Integrated-Chainmail Electrode for H2 Production through H2S Electrolysis, *Angewandte Chemie International Edition* (2025). DOI: 10.1002/anie.202502032

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