Solid oxide electrolytic cells facilitate CO2 electrolysis under intermittent renewable energy power

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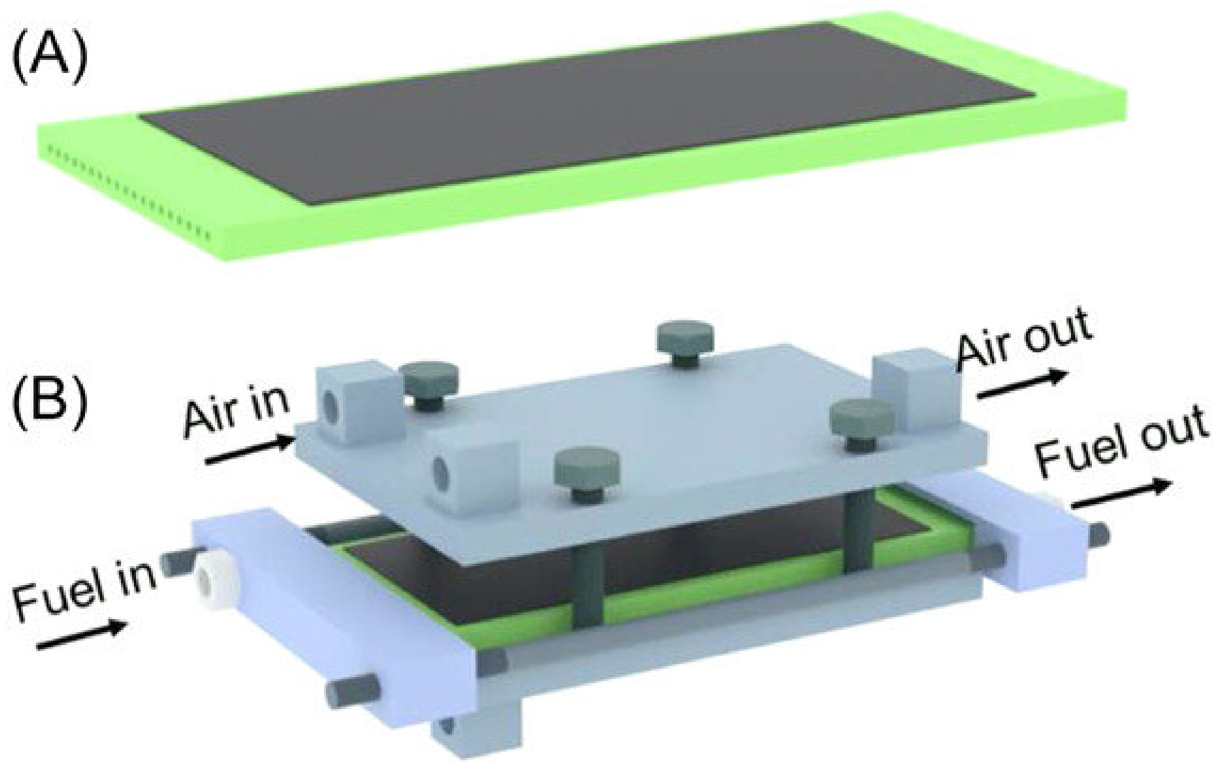

The flat-tube solid oxide electrolytic cells for CO2 electrolysis. Credit: NIMTE

Researchers at the Ningbo Institute of Materials Technology and Engineering (NIMTE) of the Chinese Academy of Sciences (CAS) have proposed a pulsed current strategy to monitor the intermittency of renewable energy, proving that the solid oxide electrolytic cells (SOECs) can realize efficient carbon dioxide (CO_2) electrolysis under intermittent renewable energy power. Their results were published in *Carbon Energy*.

CO_2 recycling for efficient reuse can help alleviate the energy crisis and climate change, thus plays a crucial role in achieving the goal of "carbon peaking and carbon neutrality." SOEC is a potential candidate device for efficient electrolytic CO_2 fuel production, owing to its high energy conversion efficiency (ECE), reversible characteristics and low comprehensive cost.

To explore the performance and reaction mechanism of CO_2 electrolysis based on SOECs under renewable energy power, the researchers at NIMTE developed a pulsed current strategy, which replicates the practical periodic fluctuations of intermittent renewable energy power.

Under the pulsed current ranging from -100 to -300 mA/cm^2 with a total operating time of about 800 h, a large-scale flat-tube SOEC with an active area of 60 cm^2 was applied for the cyclic electrolysis of CO_2.

According to the researchers, after 100 cycles, the cell voltage degraded by 0.041%/cycle upon high pulsed current density (-300 mA/cm^2), while 0.034%/cycle upon low pulsed current density (-100, -200 mA/cm^2), indicating that the theoretical lifetime of SOECs can reach up to about 500 cycles.

In addition, the total CO_2 conversion rate with the SOECs reached 52% at the current density of -300 mA/cm^2, which is close to the theoretical value of 54.3%.

Assuming that the gas in SOEC is thermally cycled, as the heat energy for heating the gas can be recovered through heat exchange, the calculated ECE approaches 98.2% at -400 mA/cm^2 (1.3 V), proving the efficiency and stability of CO_2 electrolysis employing SOECs.

This study illuminates the outstanding performance and the industrial potential of SOECs in efficient electrochemical energy conversion, carbon emission reduction, and intermittent renewable energy storage.

More information: Anqi Wu et al, Pulsed electrolysis of carbon dioxide by large-scale solid oxide electrolytic cells for intermittent renewable energy storage, *Carbon Energy* (2022). DOI: 10.1002/cey2.262

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