

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 <u>energy crisis</u> and <u>climate change</u>, 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/cm² with a total operating time of about 800 h, a large-scale flat-tube SOEC with an active area of 60 cm² was applied for the cyclic electrolysis of CO₂.

According to the researchers, after 100 cycles, the cell voltage degraded by 0.041%/cycle upon high pulsed <u>current density</u> (-300 mA/cm²), while 0.034%/cycle upon low pulsed current density (-100, -200 mA/cm²), 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/cm², which is close to the theoretical value of 54.3%.

Assuming that the gas in SOEC is thermally cycled, as the <u>heat energy</u> for heating the gas can be recovered through heat exchange, the calculated ECE approaches 98.2% at -400 mA/cm² (1.3 V), proving the



efficiency and stability of CO₂ electrolysis employing SOECs.

This study illuminates the outstanding performance and the industrial potential of SOECs in efficient electrochemical energy conversion, <u>carbon</u> emission reduction, and intermittent renewable <u>energy</u> 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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