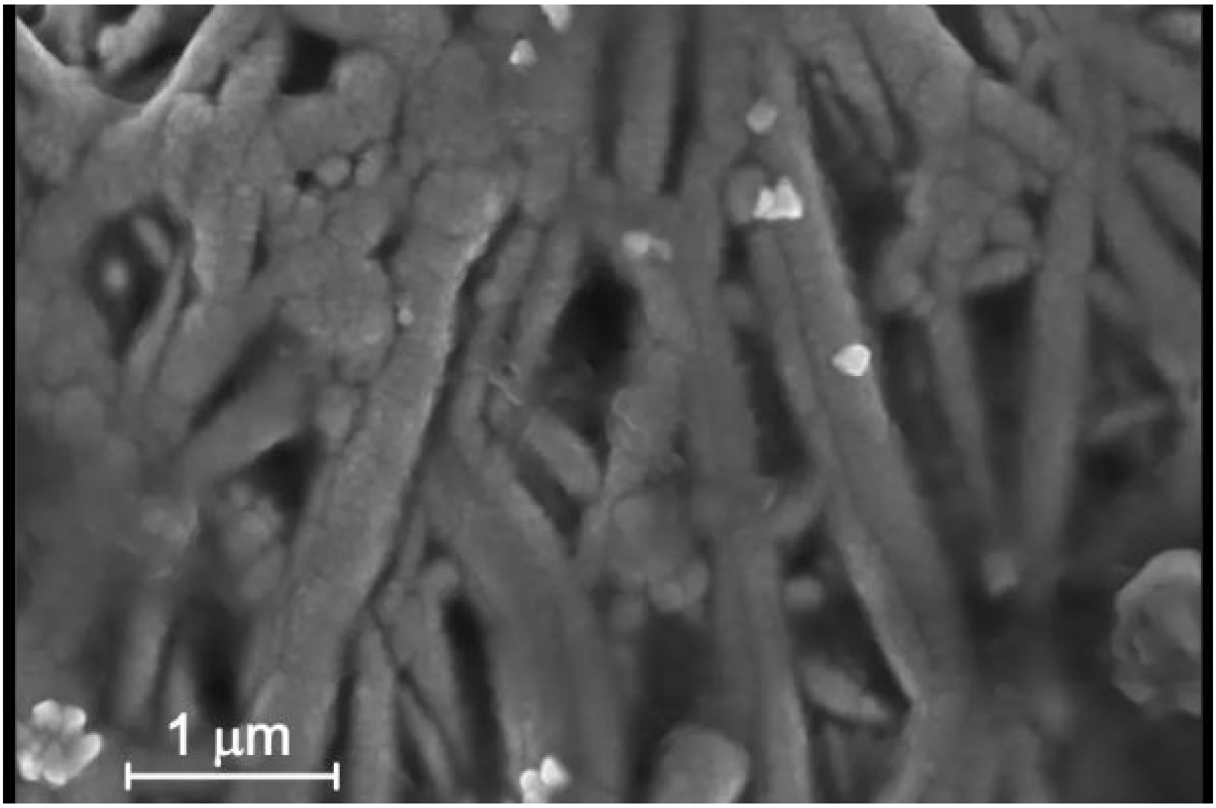

Researchers boost CO? conversion in acidic media by keeping ion traffic under control

One promising strategy to mitigate and eventually reverse greenhouse effects associated with carbon emissions is the capture and electrochemical conversion of CO? into valuable chemicals, for instance via carbon dioxide electroreduction. ICFO researchers now tackle the challenge of performing this reaction in acidic media by controlling how ions move at the catalyst surface, a fundamentally different approach complementing catalyst design and optimization. The strategy, presented in ACS Energy Letters, improves carbon efficiency, reduces parasitic reactions and maintains stability, all under industrially relevant conditions.

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Carbon dioxide electroreduction (CO2E) has recently emerged as a promising way to convert

CO_2 into useful multicarbon compounds, such as **ethylene** (the world's most widely produced organic compound, used as a precursor in the polymer industry) **and** **ethanol** (which can be readily used as a fuel and incorporated into existing supply chains).

The medium pH, however, strongly influences how the CO2E reaction unfolds, affecting both its efficiency and potential for large-scale deployment. Acidic CO2E is particularly attractive because it avoids the formation of unwanted carbonates, which severely limit the production of desired products in neutral and alkaline systems. As a downside, the high concentration of protons in acidic environments favours the formation of hydrogen gas (H?), consuming electricity that should be destined to convert CO_2 into multicarbons instead.

ICFO researchers, **Blanca Belsa**, **Dr. Anku Guha**, **Dr. Barbara Polesso**, **Ranit Ram**, **Dr. Viktoria Golovanova**, **Dr. Marinos Dimitropoulos**, **Dr. Sunil Kadam**, **Prathama Haldar**, led by **ICFO Prof. F. Pelayo Garcia de Arquer**, have recently proposed **interfacial ion transport** as a new path for addressing the challenges of acidic CO2E. Instead of modifying the catalyst itself (the element that accelerates otherwise inefficient reactions), the novel approach introduces **ion management channels** to control how ions and water move near the catalyst surface.

Published in ACS Energy Letters, this strategy creates a well-balanced chemical environment, **suppressing parasitic reactions like H_2 formation while preserving the intrinsic efficiency advantage of acidic operation**, even under **industrially relevant conditions.**

ï¿½You can think of ion management channels as traffic controllers at the reacti n interface,ï¿½ explains Blanca Belsa, first author of the article. ï¿½The ions still move, but their movement is guided in a way that promotes the desired chemical reaction,ï¿½ she cl rifies. In particular, hydroxyls (*OH) species, which can accumulate at the catalyst surface and block the active sites where multicarbon products form, are given a clear pathway away from the catalyst. Protons (H+), in turn, are guided towards the hydroxyls, recombining to create water (H?O). In this way, protons cannot reach the catalyst surface, where they would otherwise form hydrogen gas (H?). As a result, CO_2 and key reaction intermediates (like *CO) can access active sites more easily, enabling an efficient formation of ethylene, ethanol, or similar compounds.

Overall, the study demonstrates that **high carbon efficiency** (80±4%) in acidic CO_2 electrolysis can be maintained at **industrially relevant current densities** (0.5 A·cm?2) by engineering ion management channels near the catalyst surface. Importantly, the reaction's performance remains **stable over 70 hours** of continuous operation.

ï¿½By proposing a new design principle that goes beyond optimising catalysts or operati g conditions, we have opened a complementary research direction in the field,ï¿½ claims P of. Pelayo Garcia de Arquer, lead researcher of the study. ï¿½This foundational advance could eventually lead to efficient and selective CO_2 conversion technologies suitable for real-world applications, an effort we are already pursuing through research projects such as ICONIC or Helva.ï¿

Reference:
Blanca Belsa, Anku Guha, Barbara Polesso, Ranit Ram, Viktoria Golovanova, Marinos Dimitropoulos, Sunil Kadam, Prathama Haldar, Aliaksandr S. Bandarenka, and F. Pelayo Garcia de Arquer, Carbon Efficient CO2 Interfaces in Acid through Ion Management Channels, ACS Energy Letters, 2026 **11** (1), 498-507.
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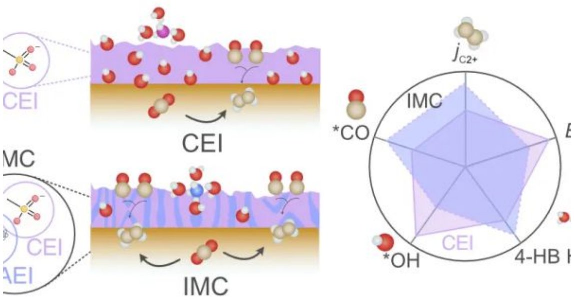

Scheme of how the ion management channels work in the presented study. Source: ACS Energy Letters.