Novel catalyst for highly selective photoelectroreduction of carbon dioxide to ethanol

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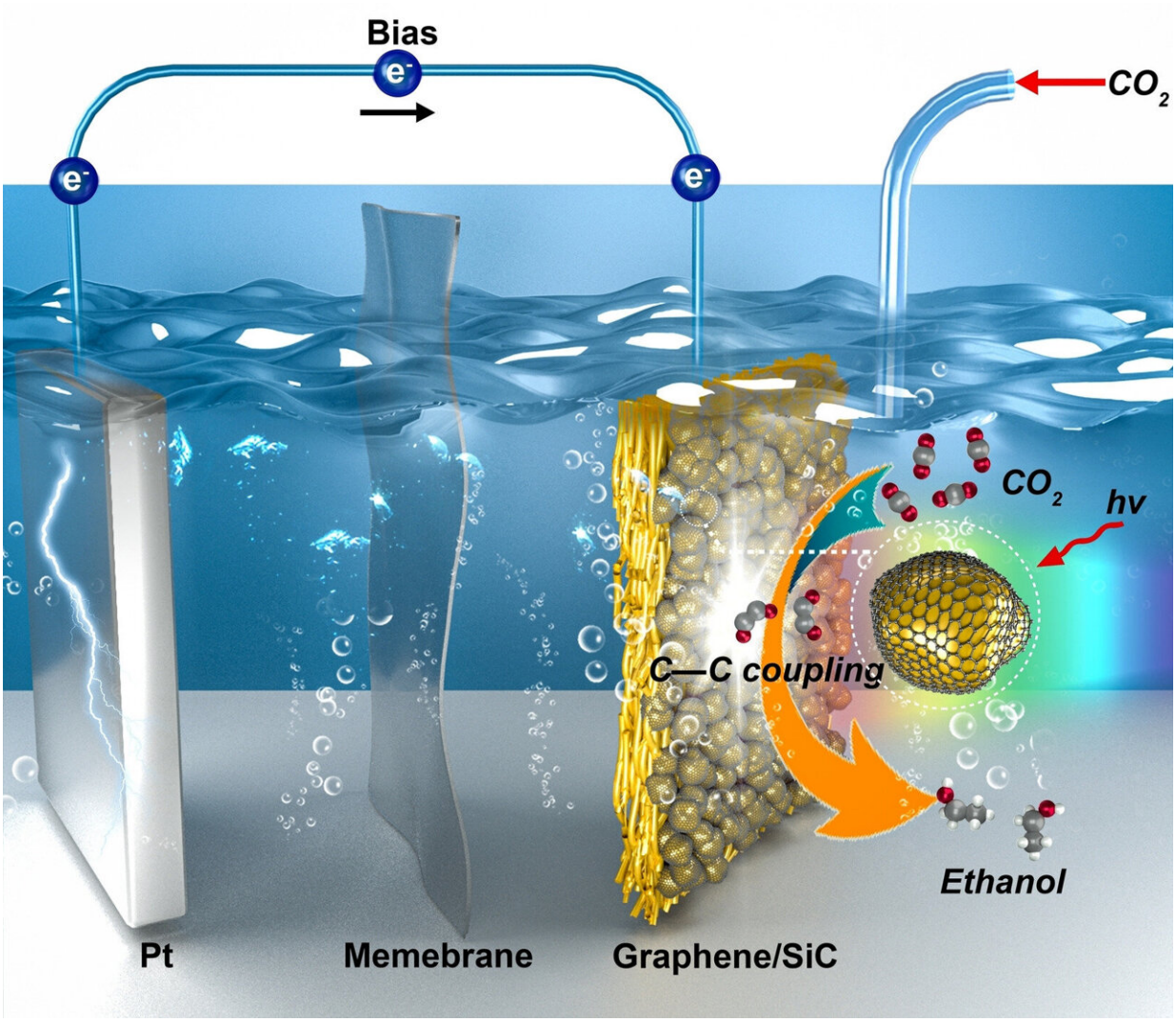

Schematic diagram for highly selective photoelectroreduction of carbon dioxide

over graphene/silicon carbide composites. Credit: SARI

Artificial photosynthesis (AP), using sunlight to produce valuable chemicals and fuels from carbon dioxide (CO_2), is a promising strategy to achieve solar energy storage as well as negative carbon cycle.

However, artificial photosynthesis is quite complex and involves multiple sequential and parallel steps. What's more, thermodynamically favorable C_1 products can be produced from multiple AP intermediates, making it challenging to selectively produce target chemicals containing C-C bonds.

Recently, a research team led by Profs. Chen Wei and Wei Wei from the Shanghai Advanced Research Institute (SARI) of the Chinese Academy of Sciences has developed novel graphene/silicon carbide (SiC) catalysts for efficient CO_2 photoelectroreduction to ethanol (C_2H_5OH).

The results were published in *Angewandte Chemie International Edition*.

The proposed composite catalyst, which comprises SiC substrate, interfacial layer (IL), and few-layer graphene overlayer, can help to achieve the precise control of active intermediates for C-C coupling.

An optimal IL structure allows photogenerated electrons from the SiC substrate to be facilely transferred to the active sites on the graphene overlayer. Reaction intermediates can then be efficiently formed and stabilized owing to their strong adsorption at the active sites and the high electron density of the graphene surface.

The researchers found that CH_3OH formation was largely suppressed in favor of C-C coupling. C_2H_5OH was therefore exclusively generated

with a selectivity of >99% and a CO_2 conversion rate of 17.1mmol $g_{cat}^{-1}h^{-1}$ under simulated solar irradiation with a small bias (-50 mV bias vs. Ag/AgCl) and ambient conditions.

Thus, the photoelectrocatalytic performance of the optimal catalyst in producing C_2 products from CO_2 was at least two orders of magnitude higher than those of the state-of-the-art AP catalysts.

More information: Guanghui Feng et al, Highly Selective Photoelectroreduction of Carbon Dioxide to Ethanol over Graphene/Silicon Carbide Composites, *Angewandte Chemie International Edition* (2023). DOI: 10.1002/anie.202218664

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