

## 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 <u>active sites</u> 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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