Researchers reveal interfacial confinement on open space of oxide–oxide catalysts

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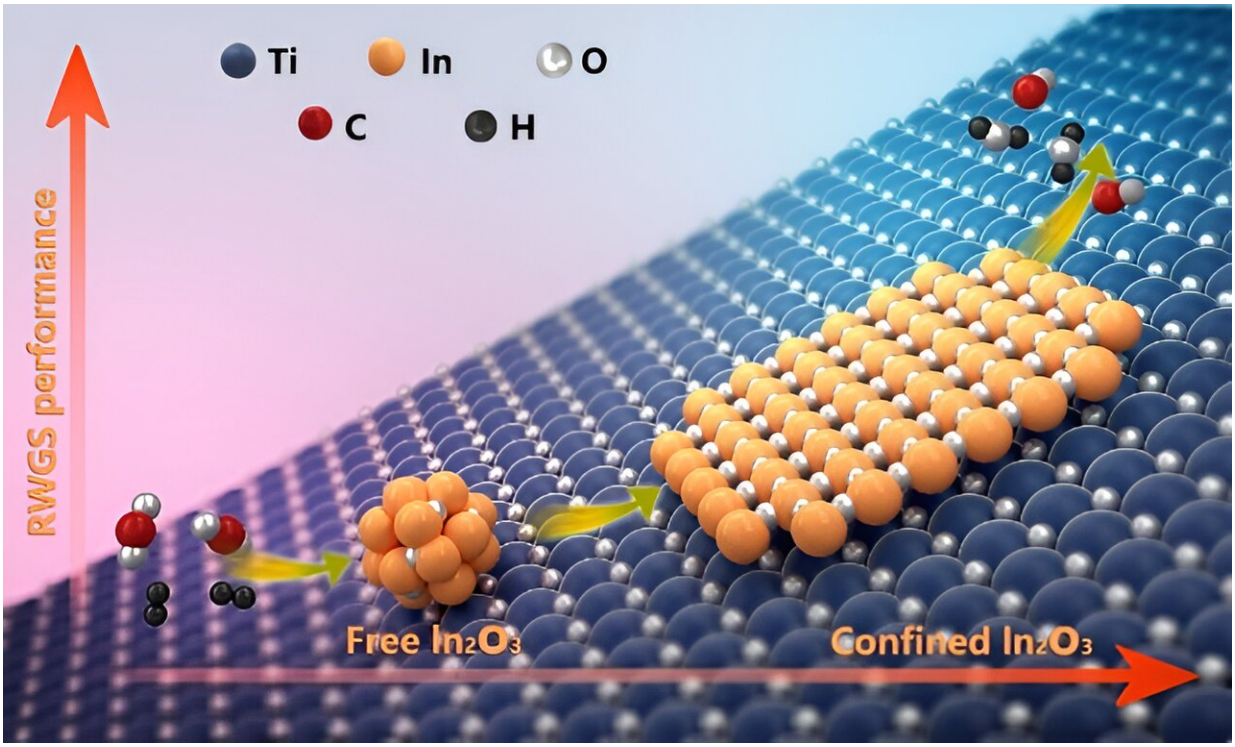

Confinement-induced indium oxide nanolayers formed on TiO_2 for enhanced CO_2 hydrogenation reaction. Credit: Wang Jianyang

Confined catalysis has been regarded as an important strategy to modulate chemical reactions and enhance catalytic performance. Previous studies have demonstrated that the applications of the confinement effect in catalysis are in enclosed nanospace. However,

whether an open space also has this effect is still unclear.

Recently, a research group led by Prof. Bao Xinhe and Prof. Fu Qiang from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) revealed the interface confinement effect on open space in an In_2O_3-TiO_2 catalyst during a reverse water gas shift (RWGS) reaction. The study is published in *Journal of the American Chemical Society*.

The researchers physically mixed In_2O_3 and TiO_2 to obtain an In_2O_3-TiO_2 catalyst for the RWGS reaction. They verified that the open surface of TiO_2 could create a confined environment for In_2O_3, which drove the spontaneous transformation of free In_2O_3 nanoparticles into In oxide nanolayers (InO_x) covering onto the TiO_2 surface during RWGS.

Additionally, the researchers found that the formed InO_x nanolayers were easy to create in surface oxygen vacancies but were against over-reduction to metallic In in the H_2-rich atmospheres, resulting in enhanced activity and stability compared with the pure In_2O_3 catalyst. They identified that the formation of interfacial In–O–Ti bonding drove the In_2O_3 dispersion and stabilized the metastable InOx layer.

Therefore, the researchers demonstrated that the InO_x overlayers with distinct chemistry from their free counterparts could be confined on various oxide surfaces, demonstrating the important confinement effect at oxide–oxide interfaces.

"The interface confinement effect plays an important role in many oxide–oxide catalysts, which can be used to enhance the catalytic performance," said Prof. Fu.

More information: Jianyang Wang et al, Confinement-Induced Indium Oxide Nanolayers Formed on Oxide Support for Enhanced CO2 Hydrogenation Reaction, *Journal of the American Chemical Society* (2024). DOI: 10.1021/jacs.3c13355

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