

New Strategy Boosting CO₂ Reduction to CO

Classical strong metal-support interaction (SMSI) describes that reducible oxide migrates to the surface metal nanoparticles (NPs) to obtain metal@oxide encapsulation structure during high-temperature H₂ thermal treatment, resulting in high selectivity and stability.

However, the encapsulation structure inhibits the adsorption and dissociation of reactant molecular (*e.g.*, H₂) over metal, leading to low activity, especially for the hydrogenation reaction.

Recently, a research group led by Dr. LIU Yuefeng from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) proposed a new migration strategy, in which the TiO₂ selectively migrates to a second oxide support rather than the surface of metal NPs in Ru/(TiO_x)MnO catalysts, boosting the CO₂ reduction to CO via reverse water-gas shift reaction.

This study was published in *Nature Catalysis* on October 9, 2023.

The researchers achieved controlled migration by utilizing the strong interaction between TiO₂ and MnO in Ru/(TiO_x)MnO catalysts during H₂ thermal treatment, and TiO₂ spontaneously re-dispersed on the MnO surface, avoiding the formation of TiO_x shell on Ru NPs for the ternary catalyst (Ru/TiO_x/MnO).

Meanwhile, high-density TiO_x/MnO interfaces were

generated during the process, acting as a highly efficient H transportation channel with low barrier, and resulting in enhanced H-spillover for the migration of activated H species from metal Ru to the support for consequent reaction.

The Ru/TiO_x/MnO catalyst showed 3.3-fold catalytic activity for CO₂ reduction to CO compared with Ru/MnO catalyst. In addition, the Ti/Mn support preparation was not sensitive to the crystalline structure and grain size of TiO₂ NPs. Even the mechanical mixing of Ru/TiO₂ and Ru/MnO_x enhanced the activity.

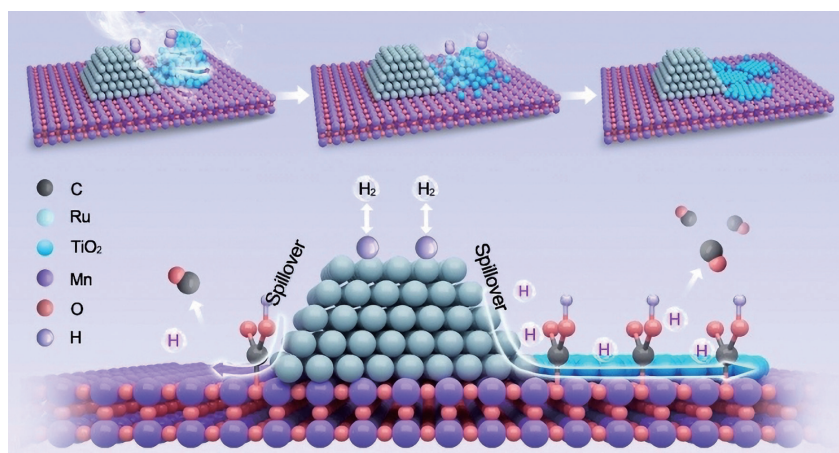
Moreover, they verified that the synergistic effect of TiO₂ and MnO didn't alter the catalytic intrinsic performance, and efficient H transport provided a large number of active sites (hydroxyl groups) for the reaction process.

“Our study provides references for the design of novel selective hydrogenation catalysts via the *in situ* creation of oxide-oxide interfaces acting as hydrogen species transport channels,” said Dr. LIU.

This study can be accessed at <https://www.nature.com/articles/s41929-023-01040-0>.

Contact:

Dr. LIU Yuefeng
Dalian Institute of Chemical Physics, Chinese Academy of Sciences
E-mail: yuefeng.liu@dicp.ac.cn



In situ generation of highly efficient H-transport channel for CO₂ reduction to CO (Image by KANG Hui)

(DICP)