Researchers tailor main-group catalyst with atomically dispersed In sites for highly efficient oxidative dehydrogenation

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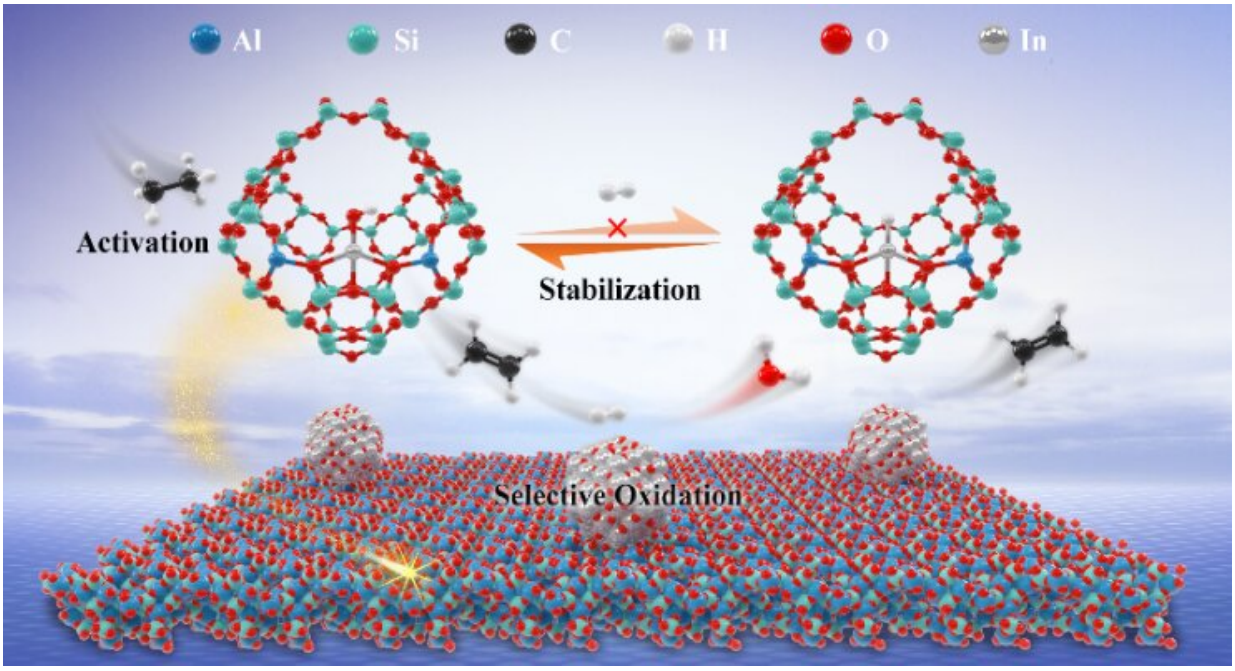

Schematic of the local coordination environment of isolated In site and proposed selective oxidative dehydrogenation process on main-group In catalyst. Credit: WANG Chaojie

Transition metal oxides are catalysts for the oxidative dehydrogenation of alkanes. However, they suffer from an inferior alkene yield due to the trade-off between conversion and selectivity induced by more reactive

alkenes than alkanes.

Recently, a research group led by Prof. Wang Xiaodong and Prof. Zhang Tao from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) proposed and demonstrated a new concept to achieve high alkene yields by regulating the activation of intrinsically selective catalysts for alkanes from weakness to strength.

This study was published in *Journal of the American Chemical Society* on Aug. 25.

The researchers designed a main-group catalyst with atomically dispersed In sites to disentangle the dilemma of trade-off between activity and selectivity in oxidative dehydrogenation process.

This novel catalyst exhibited exceeding 80% C_2H_4 selectivity at around 80% C_2H_4 conversion, thus achieving more than 60% C_2H_4 yield, which outperformed the state-of-the-art transition metal oxide catalysts.

Moreover, the researchers found that atomically dispersed $[InOH]^{2+}$ sites anchored by substituting the protons of supercages in HY enabled the activation of ethane via significantly lowering the barrier of ethane dissociation and their structure could be stabilized by H_2O formed from selective oxidation of hydrogen by In_2O_3 nanoparticles, thus exhibiting excellent performance for oxidative dehydrogenation of ethane.

"Our study unlocks new opportunities for the utilization of main-group elements and paves the way toward more rational design of catalysts for highly efficient selective oxidation catalysis," said Prof. Wang.

More information: Chaojie Wang et al, Main-Group Catalysts with Atomically Dispersed In Sites for Highly Efficient Oxidative Dehydrogenation, *Journal of the American Chemical Society* (2022).

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