Insights into the Active Sites and Kinetics of Double-site Catalysts for Semi-hydrogenation under Hydrogen Spillover

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Abstract

A well-defined catalyst with platinum (Pt) and gold (Au) encapsulated in micropore and mesopore of micro-mesoporous zeolite (TMSN), respectively, was designed to investigate the original active sites and kinetics of semi-hydrogenation. Specifically, hydrogen molecules are dissociated on Pt nanoclusters (NCs) to form hydrogen atoms that migrate to the surfaces of TMSN zeolite and Au nanoparticles (NPs). Meanwhile, the Au NPs with inferior H_2 dissociation capability in the mesopore can be served as the detector and controller of hydrogen spillover. The Pt NCs in micropore act as H_2 dissociation sites while both the Au NPs and zeolite surface are identified as the semi-hydrogenation sites. Noteworthy, the Pt-Au/TMSN catalyst with double active sites exhibits higher selectivity and rate constant ratio for semi-hydrogenation than Pt/TMSN, as well as higher turnover frequency (TOF) than Au/MSN. This work creates an effective regulation strategy of hydrogen spillover for improving active sites and kinetics of semi-hydrogenation.

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