Tailoring Dynamic Metal-Polymer Interaction for the Design of Selective and Stable Partial Hydrogenation Catalysts

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Controlling metal-support interaction is an important strategy for adjustiong the catalytic properties of supported metal catalysts. Here, premade Pd particles are supported on themochemically stable polymers with different ligating functionalities to systematically control the metal-polymer interactions. The synthesized catalysts are compared with their catalytic properties in industrially relevant partial hydrogenation of acetylene. The polymers including strongly ligating groups (e.g., Ar-SH, Ar-S-Ar) can form a polymer overlayer on the surface of Pd particles through dynamic metal-polymer interaction (DMPI), which enables exceptionally selective acetylene adsorption and its partial hydrogenation to ethylene with inhibited deactivation. In contrast, the polymers with weakly ligating groups (e.g., Ar-O-Ar) do not form an overlayer on Pd surface, which results in non-selective reaction and fast deactivation, similar to the Pd catalysts supported on conventional inorganic materials. These results imply that tuning metal-polymer interaction via rational polymer design can provide an efficient way of synthesizing highly selective and stable hydrogenation catalysts.