An efficient production of industrial organic chemicals using structure-tailored TiO_2 supported noble metal catalysts

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New heterogeneously catalytic pathways have been studied for their applications in a large number of organic syntheses. Conventionally these reactions are carried out with homogeneous catalysts or with stoichiometric transformations. Heterogeneous catalysis allows us to convert raw materials into valuable chemicals in a more economical, efficient and environmentally benign manner, in which separation and re-use of the catalysts are possible. Catalytic hydrogenation is one of the most important reactions for the synthesis of important intermediates in fine chemicals industry.

Titanium dioxide (TiO_2) is a very useful material and has received great attention in catalysis research as a catalyst, a catalyst support, and a promoter. As a catalyst support particularly in hydrogenation reaction, TiO_2 manifests a strong metal-support interaction (SMSI) with group VIII metals under high reduction temperature resulting in an improved catalytic performance. The chemical, physical, and catalytic properties of TiO_2 varied widely depending on the synthesis conditions/methods. The present work is aimed to synthesize highly active and selective catalysts for selective hydrogenation of various compounds such as phenylacetylene to styrene, 3-nitrostyrene to vinylaniline, furfural to furfuryl alcohol, and vanillin to vanillyl alcohol using noble metal (Pt, Pd, or Ru)-based catalysts supported on modified nanocrystalline TiO_2. The catalyst performances were found to depend mostly on the degree of metal-support interaction, the crystallographic of the TiO_2, and the metal deposition methods.