Effect of Pt Loading Order on Activity of Pt/TiO_2 Nanofiber in Photocatalytic Producton of H_2 from Neat Ethanol

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Abstract

TiO_2 nanofibers that are loaded with 1wt % Pt metal that is introduced at different stages of the wet impregnation procedure have very different photocatalytic activities. Two photocatalysts prepared using different procedures were denoted as PtHTN and PtB catalysts. The former was prepared by impregnating hydrogen trititanate nanofibers ($H_2Ti_3O_7$, abbreviated as HTN) directly with H_2PtCl_6, before calcining at between 573 and 873 K and then reducing at 423 K in flowing hydrogen. The latter was prepared by initially calcining HTN nanofiber at between 573 and 873 K to yield TiO_2 nanofiber, and then impregnating this TiO_2 support with H_2PtCl_6; the support was then calcined and reduced as PtHTN to produce PtB catalysts. Although most of their physical properties such as surface area, pore volume, crystalline phase composition and crystallinity, capability to absorb UV light and band gap energy are quite similar, the optimized H_2 yield over PtB catalyst in the photocatalytic dehydrogenation of neat ethanol was 1.86 times that over PtHTN catalyst. XPS and sub-ambient temperature TPR indicated that the stronger photocatalytic activity of PtB was associated with its higher surface Pt concentration and better reducibility and electron conductivity. The specific Pt impregnation order generated in the PtHTN catalyst a strong interaction between the Pt nanoparticles and the TiO_2 nanofiber surface that was not present in the PtB catalyst. This interaction was revealed by the particular microstructure at the Pt-nanofiber interface, as observed by HRTEM, which was responsible for the marked difference between the electronic properties and photocatalytic activities of the two catalysts.

Key words: Pt, titanate nanofibers, photocatalytic

Reference

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