Abstract

Controlling both size of metal nanoparticles (MNPs) and acidobasic characteristics of the zeolite support is highly desirable for preparation of stable and active bifunctional catalysts. 2D-3D transformation of layered zeolite precursor into three-dimensional zeolite coupled with metal encapsulation is one of the most efficient synthetic strategies so far to achieve the appropriate metal dispersion and aggregative stability of MNPs within zeolite matrix. Nevertheless, the effect of support acidic characteristics on the properties of thus prepared metal@zeolite catalyst remained unrevealed, while the synthetic strategy itself requires further optimization to minimize the loss of metal component. This work addresses the influence of chemical composition of zeolite layered precursor on physical-chemical and catalytic properties of metal@zeolite catalysts prepared *via* 2D-3D transformation strategy, taken Pd@MCM-22$_{2D-3D}$ system as a representative example. Both Si/Al ratio of MCM-22P layered precursor (e.g., Si/Al = 15, 20, 30) and Pd loading (e.g., 0.1, 0.3, 0.8 wt.%) were varied resulting in a set of nine Pd@MCM-22$_{2D-3D}$ catalysts. In addition, three Pd@MCM-22$_{impreg}$ catalysts with the same metal loading (0.1 wt.%), but different Si/Al ratios of a support were synthesized *via* conventional impregnation method and used as benchmarking materials. Thus, prepared Pd@MCM-22 catalysts were characterized by various techniques, such as XRD, nitrogen physisorption, electron microscopy, FTIR spectroscopy, while their catalytic performance was tested in hydrogenation of 3-nitrotoluene to 3-aminotoluene.

Key words: zeolites, metal nanoparticles, heterogeneous catalysts, material design