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Cobalt nanoparticles immobilized in 3D mesoporous silica KIT-6 for excellent catalytic hydrogen generation from ammonia borane

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Hydrogen is highly considered as the most important issue in fuel cell. Apart from this, ammonia borane is a popular reagent owing to its high hydrogen density up to ~19.6 wt%. In the field of catalytic hydrogen generation, cobalt nanoparticles (Co NPs) based materials are usually high potential candidates for hydrolysis of ammonia borane. However, the stability issue of Co NPs due to the particle aggregation resulting uncontrollable activity. Therefore, we here report the convenient way synthesis of Co NPs through one-step chemical reduction which is adsorbed in 3D mesoporous silica KIT-6 (denoted as Co@KIT-6) to keep maintain the high efficiency. Under wet impregnation process, KIT-6 support was immersed in cobalt ion precursor and the adsorbed cobalt ion into inside the pores was then chemically reduced using mixed reagent containing NaBH4 and NH3BH3 to obtain Co@KIT-6(1). It was found that the use of KIT-6 support can highly enhance the dispersion and efficiency due to its high surface area 880 m2/g and pore volume 0.9 cm3/g. In addition, KIT-6 with the internal pore size of 5 nm may separate confine the Co NPs and subsequently avoid the aggregation. Because cobalt is regulated in 3D structure, it can suffer from rapid deactivation and promote catalytic activity to reach high reuse times. According to X-ray diffraction pattern and TEM image, it can be confirmed that the particle size of Co NPs is about sub-1 nm and highly dispersed without aggregation. The turnover frequency (TOF) and activation energy (Ea) of Co@KIT-6 for the hydrolysis of ammonia borane reach almost 20 mol_{H2} mol_{Co}^{-1} min^{-1} and 26 kJ mol^{-1}. In this study, Co@KIT-6 exhibits a high promising catalyst for hydrogen generation from ammonia borane.

Biography

Mu-Hsin Lee joined the master program in Department of Chemistry, National Central University, Taiwan, in 2015. For his master study, his research focuses on the nanomaterials fabrication including mesoporous silica support, metal nanoparticles and nanostructures with the main application on catalytic process for hydrogen generation. He published his work of about hydrogen evolution inRSC Advance (2015) titled as"Silica aerogel-supported cobalt nanocomposites as efficient catalysts toward hydrogen generation from aqueous ammonia borane". His research and academic background allow him to achieve scholarship award from his school.

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