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Enhanced catalytic activity of Ag-Ni alloyed nanoparticles immobilized in –COOH functionalized SBA-16 for the reduction of 4-nitrophenol

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Superior catalysts for the catalytic reduction of 4-nitrophenol (4-NP) based on alloyed bimetallic system of Ag-Ni nanoparticles have been successfully fabricated by facile immobilizing technique within the cage-pores of carboxylic acid –COOH functionalized mesoporous silica SBA-16 (named AgxNi1-x@S16C, where x is molar ratio), following procedure in our previous works with further modification.1,2It was greatly acknowledged that the –COOH functional groups on mesostructure silica support play a critical role in improving the interaction with target cation and confining the crystallite growth during calcination-reduction process.3,4Under wet impregnationin basic condition, the negatively charged density of S16C support (as confirmed by zeta potential measurement) endows effective sites to undergo ionic interaction withAg(I)/Ni(II) cation. The successful functionalization of the organic functional group on the silica framework were well identified with detailed 13C cross polarization magic angle spinning nuclear magnetic resonance (CPMAS NMR), 29Si MAS NMR, and Fourier transform infrared (FT-IR) spectroscopy.5It worth noting that without stabilizing or reducing agents, the highly dispersed Ag-Ni nanoparticles immobilized in cage-pores of S16C could be achieved by calcination-reduction process under inert conditions. Further characterizations, alloying bimetallic of Ag-Ni nanoparticle has been confirmed by the powder X-ray diffraction, X-ray photoelectron spectroscopy, energy-dispersive X-ray analysis and high resolution transmission electron microscopy. Interestingly, the presence of Ni in bimetallic alloy system could decrease the size of Ag-Ni NPs up to sub-3 nm, much smaller than that of only Ag NPs. As the catalyst for the reduction of 4-NP, the Ag0.4Ni0.6@S16C and Ag0.6Ni0.4@S16C perform much higher catalytic activity over monometallic counterparts. This enhanced catalytic activity might be attributed to the size, loading amount, high specific surface area, well-dispersed and unique electronic properties arising from Ag-Ni bimetallic system supported in cage-type S16C. Furthermore, their magnetic properties allowing a facile and rapid recycle technique for reuse.

Biography

As the PhD researcher in Department of Chemistry, National Central University, Taiwan, Canggih Setya Budi focuses his research interests on fabrication of nanomaterials including mesoporous materials, metal nanoparticles, bimetallic alloyed nanoparticles, nano-composites and their utilization for the energy storages and catalytic reactions. His academic and research skill are well distinguished and enabling him to publish his research in good journal and achieve academic scholarship from Taiwan government. He is actively involved as the member of High Energy Battery and Nano-catalyst Research Group which enabling him to share the current issues and ideas among the researchers.For about one and half years, he also experienced to work in Research and Development (R&D) division at Pura Barutama Ltd. Co., as the largest paper and printing company in South-East Asia.

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