SYNTHESIS, CHARACTERIZATION AND CATALYTIC APPLICATION OF DENDRIMER-MEDIATED NICKEL AND IRON ALLOY NANOPARTICLES CONTAINING AN AVERAGE OF 40 ATOMS

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Bimetallic nanoparticles (NPs), composed of two different metals, have recently drawn great interest in the field of catalysis because bimetallization makes it possible to obtain catalysts with improved catalytic activity that may not be achieved with monometallic nanoparticles [1]. In addition, the size of the metal particles plays an important role in the activity and selectivity of catalysts, and an enhancement in the catalytic properties has been previously shown for monodisperse particles with ~1nm of diameter [2]. Here we report the synthesis and characterization of different ratios of Fe-Ni bimetallic nanoparticles of < 2nm diameter supported on SiO_2 for the study of the catalytic activity in the ethylene hydrogenation reaction.

The nanoparticles were synthesized within a hydroxyl-terminated fourth generation poly-aminoamide (PAMAM) Dendrimer (G4-OH), a hyperbranched polymer, in aqueous solution and then immobilized by depositing onto a CAB-O-SIL® M-5 Silicon dioxide support. UV-Vis absorption spectrophotometry was used to monitor the coordination process between $Fe^{(+3)}$ and $Ni^{(2+)}$ metals ions and the internal tertiary amine groups of the dendrimers. Transmission Electron Microscopy and X-ray absorption spectroscopy were used to measure the size and distribution of the zerovalent metals after reduction of the coordinated metal ions. Catalytic activity of the supported Fe-Ni nanoparticles was studied with ethylene hydrogenation at different temperatures after hydrogen reduction pretreatment at 523 K.

Reference

1. J. H. Sinfelt, Acc. Chem. Res., Vol. 20 p. 134, 1987.

2. Huang, W. et al., Nano Letters. Vol. 8, No. 7 p. 2027, 2008.