Shape effect of Ag-Ni binary nanoparticles on surface catalytic reaction aided by surface plasmon

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Plasmonic catalysts are interesting heterogeneous catalysts that enable surface reactions more easily aided by light. Ag-Ni binary nanoparticles are prepared herein, in which the Ag part is used as a light collector and the Ni part is used as a heterogeneous catalyst. Different shapes of dumbbell and core-shell nanoparticles are synthesized by modulating the lattice strain. Anisotropic overgrowth of Ni with a hexagonal close packed (hcp) structure on Ag cores with a face-centered cubic (fcc) structure produces the dumbbell shape, whereas isotropic overgrowth of Ni with fcc structure on Ag cores generates the core-shell shape. Stokes shift, which indicates non-radiative energy consumption of incident light, is estimated by comparing UV-Vis absorption spectra and photoluminescence emission spectra. This shift is much larger for the dumbbell shaped particles. When the different shapes of binary nanoparticles are tested for the catalytic hydrogenation of 4-nitrophenol, a significant enhancement of the reaction rate is observed for the dumbbell shape by a factor of 6. On the other hand, the core-shell shape presents only a slight enhancement by a factor of 1.5.