Controlled synthesis of active metal nanocatalysts within pH-responsive microgel particles

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Polymer microgel particles can be used as 'nanoreactors' for the controlled synthesis of metal nanoparticles (NPs). The use of microgel particles as templates for the in-situ formation of metal nanocatalysts has certain advantages over other polymer matrices, i.e., their facile preparation and functionalization, adjustable size, enhanced colloidal stability over a wide pH range as well as in organic solvents, and their high porosity depending on their cross-link density and the environmental conditions [1]. In this work, electrostatically and sterically stabilized pH-responsive microgel particles based on poly(2-(diethylamino)ethyl methacrylate, (PDEA), poly(acrylic acid), (PAA), and poly(methacrylic acid), (PMAA), were prepared by a free radical emulsion copolymerization process. The pH-sensitive microgels prepared were, then, used as templates for the growth of palladium (Pd), ruthenium (Ru), platinum (Pt) and bimetallic platinum/vanadium (Pt/V) NPs. These metal nanocatalysts were formed within the PDEA, PAA and PMAA microgels following a two-step process (Figure 1a). First metal precursors capable to interact with the polymer functional groups (tertiary amine and carboxylic acid for PDEA and PAA/PMAA, respectively) were incorporated within the microgel particles. In the second step, the metal species were reduced to produce the catalytically active metal NPs within the microgels [2]. The microgel-based nanocatalysts were characterized by dynamic light scattering, thermogravimetric analysis, transmission electron microscopy (TEM), X-ray diffraction and X-Ray photoelectron spectroscopy. Representative, TEM images show the homogeneous distribution of Ru and Pt/V NPs within the PDEA microgels and verify the controlled synthesis of monodisperse metal nanoparticles (Figure 1b).

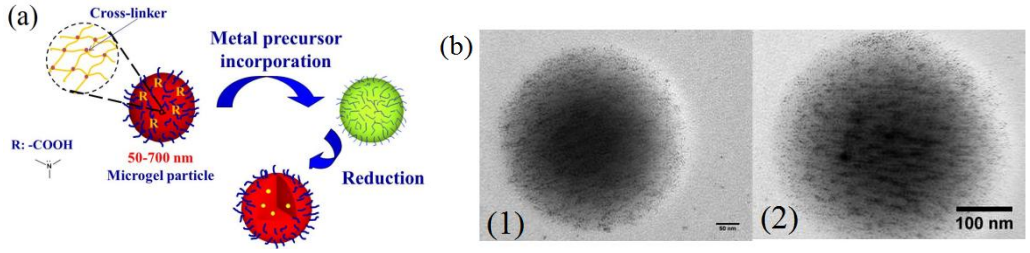

Figure 1: (a) Schematic representation of the synthesis of metal nanoparticles within the microgel particles (b) TEM images of Ru (1) and Pt/V (2) NPs within the PDEA microgels.

References

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