Synthesis and Characterization of Monodisperse Nickel Nanoparticles using a Microreactor

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Nickel nanoparticles have attracted much attention because of their applications as catalysts and conducting and magnetic materials. Catalytic and magnetic properties are dramatically dependent on the particle size and are sensitive to their microstructures. It is thus of great importance to synthesize monodisperse nickel nanoparticles with controlled size to meet various demands. The particle size is, however, quite difficult to control by using a batch reactor system. A microreactor is a possible alternative which is especially suitable for fast reactions because it has higher mixing performance than that of a batch reactor. We have succeeded in the continuous synthesis of monodisperse platinum nanoparticles by using a micromixer instead of a conventional batch reactor system, which demonstrates the effectiveness of the micromixer in the nanoparticle synthesis.

In the present study, we applied the micromixer to the nickel particle synthesis. Nickel nanoparticles were synthesized via the reduction of nickel salt by hydrazine in an aqueous cetyltrimethylammonium bromide (CTAB) solution [Wu and Chen, *Chem. Lett.*, **33**, 406–407 (2004)]. Hydrazine aqueous solution and aqueous solution of nickel(II) chloride and CTAB were mixed with a y-shaped tube connecter. Then the mixed solutions and sodium hydroxide aqueous solution were mixed with a micromixer (Figure 1). We investigated the effect of the mixing performance on the particle size and size distribution by changing hydrazine concentration. X-ray diffraction (XRD) revealed that the resultant particles were pure nickel crystalline with a face-centered (fcc) structure. Also, X-ray photoelectron spectroscopy (XPS) measurement showed that the surface of the resultant particles was partially oxidized in air. TEM images of resultant particles confirmed that the micromixer can produce smaller particles with narrower size distribution than those made with the batch system.

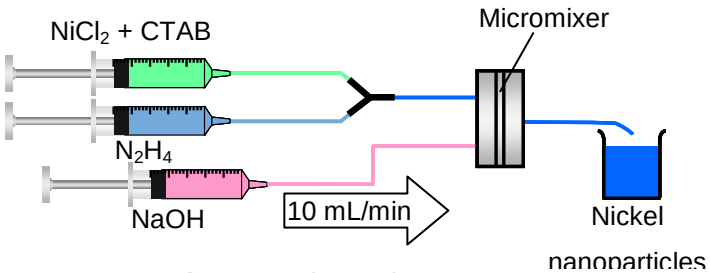

Fig. 1 Exrerimental setup