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Full Length Research Paper

Synthesis and characterization of Nickel hydroxide/ oxide nanoparticles by the complexation-precipitation method

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In the present research work, the synthesis of Ni $(OH)_2$ and NiO nanoparticles with narrow size distribution and uniform shape, by complexation-precipitation method using ammonia as complexing agent, was investigated. The reactions were carried out at the temperature about 70°C in the solution and the precipitated nickel hydroxide precursor, in the form of the nanosized soft agglomerates, was calcined at 300 and 400°C. The hydroxide and the oxide samples were then characterized by XRD, SEM, and IR spectroscopy. The NiO particles obtained after calcination at 300°C, could preserve the size and shape of the precursor material, whereas, the one obtained after calcination at 400°C showed a slight change in the size and morphology of the particles. In general, the results indicate that using this method, $Ni(OH)_2$ and NiO nanoparticles, with homogeneity in size and shape, suitable for various applications, can be prepared.

Key words: Complexation-precipitation, Ni hydroxide/oxide, nanoparticles, synthesis, characterization.

INTRODUCTION

Nanostructured materials have been extensively explored for the fundamental scientific and technological interests in accessing new classes of functional materials with unprecedented properties and applications (Wu et al., 2007; Neuberger et al., 2005; Schiffrin, 2001; Ramesh et al., 2006; The-Long et al., 2008). In recent years, there has been an increasing interest in the synthesis of nanosized crystalline metal oxides because of their large surface areas, unusual adsorptive properties, surface defects and fast diffusivities (Ying et al., 2007). Nickel oxide (NiO) is a very important material extensively used in catalysis, battery cathodes, gas sensors, electrochromic films, and magnetic materials (Yoshio et al., 1998; Moon et al., 1995; Alcantara et al., 1998; Wu et al., 2008; Miller and Rocheleau, 1997; Gabr et al., 1992) . Recently, several methods have been developed to prepare ultrafine nickel oxide powder, including low-pressure spray pyrolysis (Lenggoro et al., 2003), surfactant-mediated method (Wang et al., 2002), simple liquid phase process (Wang et al., 2005) and other techniques (Tao and Wei, 2004; Wang and Ke, 1996; Cherrey et al., 2002 Souza et al., 2007). In many of them, the main objective is to producue non-agglomerated nanoparticles with reduced costs and technological applications (Souza et al., 2007).

In the present research work therefore, synthesis of $Ni(OH)_2$ and NiO nanopowders by the complexation-precipitation method using ammonium hydroxide, as the complexing agent has been investigated. This method has been found to be simple, cheap, capable of being scaled up, which would result in production of nanosized $Ni(OH)_2$ powders as well as NiO nanoparticles with homogeneity in size and shape, making the products as suitable compounds for application in rechargeable batteries, heterogeneous catalysts and etc.

EXPERIMENTAL

Materials

All the chemical reagents used in this study were of analytical grade and are used without further purification. Distilled water was used

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