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Size-controlled synthesis of CoCO_3 and Co_3O_4 nanoparticles by free-surfactant hydrothermal method

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ABSTRACT

Uniform cobalt carbonate nanopowders were synthesized through free-surfactant hydrothermal treatment of a mixture of cobalt acetate and ammonium carbonate in an autoclave. The size, phase and purity of CoCO_3 particles were controlled by adjusting reaction time (05–24 h), temperature (80–160 °C), and (1:6–1:0.5) ($\text{Co}^{2+}:\text{CO}_3^{2-}$) molar ratios. Pure cobalt carbonate nanoparticles were obtained in high yield (94%) at 120 °C for 0.5 h, with (1:3) ($\text{Co}^{2+}:\text{CO}_3^{2-}$) molar ratio and crystallite size in ranges 80–90 nm. Moreover, cobalt oxide nanoparticles with an average crystallite size of 25 nm have been obtained by thermal decomposition of cobalt carbonate microspheres at 300 °C for 2 h. Chemical structure of the products was confirmed by powder X-ray diffraction (XRD) and Fourier transform infrared (FT-IR). Morphology of the products was investigated by transmission electron microscope (TEM) and scanning electron microscope (SEM). Optical properties of Co_3O_4 nanoparticles revealed the presence of two band gaps (2.0 and 1.46 eV) whose values confirm the purity and semiconducting properties of the oxide.

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