

## PHASE CONTROL OF NICKEL SULFIDE HIERARCHICAL STRUCTURES

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### Abstract

Nickel sulfide is of importance in the metal sulfide family because of the variety in its phases and diversity in applications such as in lithium ion batteries, supercapacitors, and dye-sensitized solar cells. Synthesis of nickel sulfide hierarchical structures was carried out by hydrothermal method using nickel nitrate hexahydrate and thiourea as nickel and sulfur sources, respectively. The addition of Ethylenediaminetetraacetic acid controlled the monodispersed morphology and size. The effects of source materials concentrations on the structure and morphology were analyzed by powder X-ray diffraction, scanning electron microscope and transmission electron microscope. When the concentration of sulfur to nickel ratio was in equal ratio 1:1, (0.50 mol thiourea & 0.50 mol nickel nitrate), cubes-composed hierarchical architectures of single nickel sulfide phase ( $\text{Ni}_3\text{S}_4$ ) with unreacted sulfur phase were synthesized. By increasing the sulfur source to 0.75 mol (0.50 mol nickel nitrate), thin sheets-composed hierarchical structures of the two different phases of nickel sulfide ( $\text{Ni}_3\text{S}_4$  and  $\text{Ni}_{17}\text{S}_{18}$ ) and unreacted sulfur phase were obtained. Further increasing the concentration of sulfur to nickel ratio to two times 2:1 (1.0 mol thiourea & 0.50 mol nickel nitrate), sheet-like hierarchical structures of nickel sulfide phases ( $\text{Ni}_3\text{S}_4$  and  $\text{Ni}_{17}\text{S}_{18}$ ) were formed. It was found that the phase and hierarchical morphologies of the nickel sulfide were controlled by varying the source concentration.

**Keywords:** Nickel sulfide, Hydrothermal method, Hierarchical structures, Phase transformation

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