Facile self-assembly synthesis of high-quality disc-like heterogenite (CoOOH) nanomaterials

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Heterogenite (CoOOH) is a scarce mineral and may be found as a black coating on malachite. The mineral in nature was found to be amorphous, with no crystalline form or imitative shape. As a Co (III) - bearing mineral, heterogenite (CoOOH) can be used for making submicron cobalt powders (Singh and Mendenhall, 2004). In the recent year, transition metal hydroxide and oxide have attracted intense interest of materials scientists due to their applications in batteries, catalysts, gas sensors, etc (Yang et al., 2010). CoOOH has been reported as an effective gas sensor for CO detection (Geng et al., 2008) and versatile catalyst precursors (Chen et al., 2008).

Nanoscaled building blocks for nano-devices have their optimized properties such as large surface- to-volume ratio, full of nanotips or nanoplates. To explore material potential industry applications in optics, mechanics, magnetic, electronics, catalysis, research into nanostructures has increased rapidly (Yang and Frost, 2008; Yang et al., 2009a; Yang et al., 2009b; Yang et al., 2009c; Zhao et al., 2008; Zhao et al., 2009). Herein, we report a facile self-assembly method for the synthesis of high-quality disc-like heterogenite (CoOOH) nanomaterials by a one-step hydrothermal synthesis at low temperatures. Cobalt (II) nitrate and sodium hydroxide were used as precursors, peroxide was used as the oxidizing agent, and no morphology-directing agents were needed. Varying synthesis conditions were investigated and uniform nanodiscs were obtained with an average diameter of 870 nm and thickness of 70 nm (Fig. 1). The results of X-ray diffraction indicated that the synthetic heterogenite (CoOOH) nanomaterial had a brucite-like structure with an interlayer spacing of 4.43 Å. A combination of techniques were applied for a further study on morphology and structure of the as-prepared materials, including Raman spectroscopy, scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray photoelectron spectrometer (XPS) and thermal analysis. The present study is helpful not only for controlling synthesis of heterogenite (CoOOH) nanostructures, but also for proposing a promising transition metal oxyhydroxide nanomaterial, which has large active surface area, for the catalyst industry.

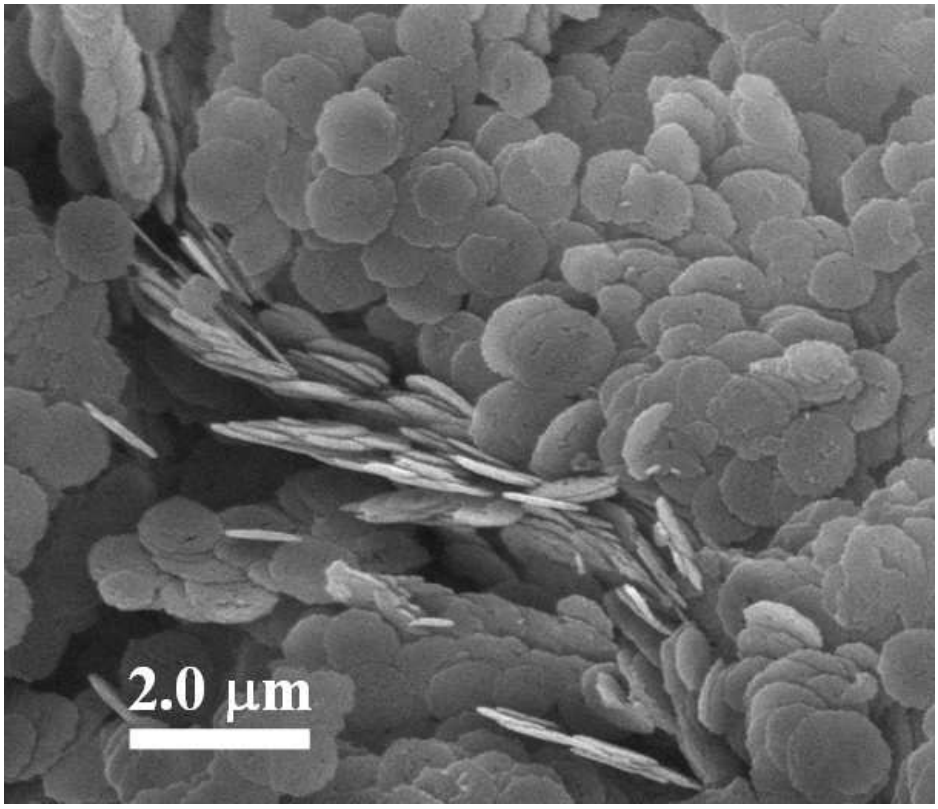

Fig. 1. SEM image of the synthetic heterogenite (CoOOH) nanomaterials.

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