

Influence of nature of the precipitating agent and chemical-thermal treatment on the phase composition of cerium-containing layered double hydroxides

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Abstract

The synthesis of rare earth containing layered double hydroxides is connected with several problems, because the ionic radii of rare earth metal cations are quite large. In the case of cerium, its trivalent cation is easily oxidized to tetravalent state, and this adds more difficulties. In the current paper, coprecipitation method followed by hydrothermal or microwave-hydrothermal treatment was selected for obtaining nickel-cerium-aluminum layered double hydroxide. Urea or sodium hydroxide was used as precipitating agent. Aluminum, nickel and cerium nitrates taken in stoichiometric ratio served as precursors for the syntheses. Powder X-ray diffraction shows reflections of impurity phase, which belong to tetravalent cerium compounds (presumably it was cerium(IV) oxide) in all samples obtained with urea hydrolysis. Using sodium hydroxide under microwave-hydrothermal conditions does not allow reaching the desired result. Oxidation of cerium(III) to cerium(IV) is likely to occur faster than the precipitation and formation of layered structure. Creation of reducing media by means of ethylene glycol addition did not prevent the oxidation though it decreased a content of cerium oxide in products. The most efficient technique for incorporation cerium into the structure of metal-hydroxide layers is coprecipitation with sodium hydroxide followed by hydrothermal treatment. This method allows obtaining single phase cerium-containing layered double hydroxide with good crystallinity. Incorporation of cerium is confirmed by energy-dispersive X-ray spectroscopy. Cerium content was shown to achieve 3%.

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