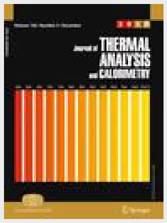
期刊文章



Synthesis and thermal stability of hydrotalcites based upon gallium

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摘要

Abstract
Hydrotalcites based upon gallium as a replacement for aluminium in hydrotalcite over a Mg/Al ratio of 2:1 to 4:1 were synthesised. The *d*(003) spacing varied from 7.83 Å for the 2:1 hydrotalcite to 8.15 Å for the 3:1 gallium containing hydrotalcite. A comparison is made with the Mg/Al hydrotalcite in which the *d*(003) spacing for the Mg/Al hydrotalcite varied from 7.62 Å for the 2:1 Mg hydrotalcite to 7.98 Å for the 4:1 hydrotalcite. The thermal stability of the gallium containing hydrotalcite was determined using thermogravimetric analysis. Four mass loss steps at 77, 263–280, 485 and 828 °C with mass losses of 10.23, 21.55, 5.20 and 7.58% are attributed to dehydration, dehydroxylation and decarbonation. The thermal stability of the gallium containing hydrotalcite is slightly less than the aluminium hydrotalcite.

Keywords

Hydrotalcite, Hydrocalumite, Gallium, Synthesis, Thermal stability

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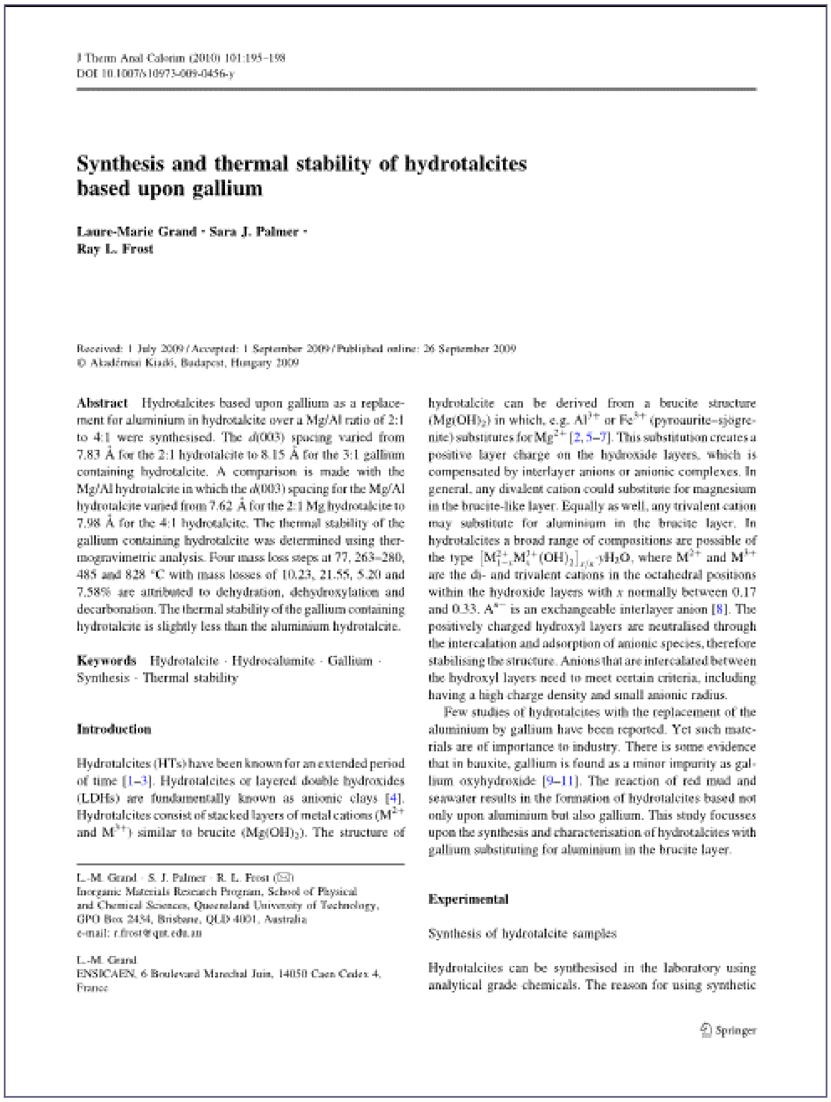

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Synthesis and thermal stability of hydrotalcites based upon gallium

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Abstract Hydrotalcites based upon gallium as a replacement for aluminium in hydrotalcite over a Mg/Al ratio of 2:1 to 4:1 were synthesised. The *d*(003) spacing varied from 7.83 Å for the 2:1 hydrotalcite to 8.15 Å for the 3:1 gallium containing hydrotalcite. A comparison is made with the Mg/Al hydrotalcite in which the *d*(003) spacing for the Mg/Al hydrotalcite varied from 7.62 Å for the 2:1 Mg hydrotalcite to 7.98 Å for the 4:1 hydrotalcite. The thermal stability of the gallium containing hydrotalcite was determined using thermogravimetric analysis. Four mass loss steps at 77, 263–280, 485 and 828 °C with mass losses of 10.23, 21.55, 5.20 and 7.58% are attributed to dehydration, dehydroxylation and decarbonation. The thermal stability of the gallium containing hydrotalcite is slightly less than the aluminium hydrotalcite.

Keywords Hydrotalcite · Hydrocalumite · Gallium · Synthesis · Thermal stability

Introduction

Hydrotalcites (HTs) have been known for an extended period of time [1–3]. Hydrotalcites or layered double hydroxides (LDHs) are fundamentally known as anionic clays [4]. Hydrotalcites consist of stacked layers of metal cations (M^{2+} and M^{3+}) similar to brucite ($Mg(OH)_2$). The structure of hydrotalcite can be derived from a brucite structure ($Mg(OH)_2$) in which, e.g. Al^{3+} or Fe^{3+} (pyroaurite–sjögrenite) substitutes for Mg^{2+} [2, 5–7]. This substitution creates a positive layer charge on the hydroxide layers, which is compensated by interlayer anions or anionic complexes. In general, any divalent cation could substitute for magnesium in the brucite-like layer. Equally as well, any trivalent cation may substitute for aluminium in the brucite layer. In hydrotalcites a broad range of compositions are possible of the type $[M^{2+}_{1-x}M^{3+}_x(OH)_2]_{x/n} \cdot yH_2O$, where M^{2+} and M^{3+} are the di- and trivalent cations in the octahedral positions within the hydroxide layers with *x* normally between 0.17 and 0.33. A^{n-} is an exchangeable interlayer anion [8]. The positively charged hydroxyl layers are neutralised through the intercalation and adsorption of anionic species, therefore stabilising the structure. Anions that are intercalated between the hydroxyl layers need to meet certain criteria, including having a high charge density and small anionic radius.

Few studies of hydrotalcites with the replacement of the aluminium by gallium have been reported. Yet such materials are of importance to industry. There is some evidence that in bauxite, gallium is found as a minor impurity as gallium oxyhydroxide [9–11]. The reaction of red mud and seawater results in the formation of hydrotalcites based not only upon aluminium but also gallium. This study focusses upon the synthesis and characterisation of hydrotalcites with gallium substituting for aluminium in the brucite layer.

Experimental

Synthesis of hydrotalcite samples

Hydrotalcites can be synthesised in the laboratory using analytical grade chemicals. The reason for using synthetic

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