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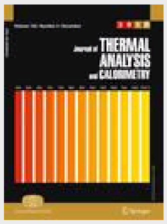

Thermoanalytical studies of silver and lead jarosites and their solid solutions

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摘要

Abstract

Dynamic and controlled rate thermal analysis has been used to characterise synthesised jarosites of formula $[M(Fe)_3(SO_4)_2(OH)_6]$ where M is Pb, Ag or Pb–Ag mixtures. Thermal decomposition occurs in a series of steps. (a) dehydration, (b) well defined dehydroxylation and (c) desulphation. CRTA offers a better resolution and a more detailed interpretation of water formation processes via approaching equilibrium conditions of decomposition through the elimination of the slow transfer of heat to the sample as a controlling parameter on the process of decomposition. Constant-rate decomposition processes of water formation reveal the subtle nature of dehydration and dehydroxylation. CRTA offers a better resolution and a more detailed interpretation of the decomposition processes via approaching equilibrium conditions of decomposition through the elimination of the slow transfer of heat to the sample as a controlling parameter on the process of decomposition. Constant-rate decomposition processes of non-isothermal nature reveal separation of the dehydroxylation steps, since in these cases a higher energy (higher temperature) is needed to drive out gaseous decomposition products through a decreasing space at a constant, pre-set rate.

Keywords

Jarosite, Thermal analysis, Controlled rate thermal analysis, Thermogravimetry

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Keywords Jarosite · Thermal analysis · Controlled rate thermal analysis · Thermogravimetry

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Introduction

Argentojarosite ($AgFe_3^{3+}(SO_4)_2(OH)_6$) was first identified in 1923 from the Titanic Standard mine at Dividend, Utah, USA [1]. It has since been identified in at least 14 other US sites. The mineral in some localities is of sufficient abundance as to be a silver bearing ore [2]. Argentojarosite was exploited at Rio Tinto, Spain, from Roman or even pre-Roman times [3]. Argentojarosites had an important influence on the wealth of both Europe and South America [4]. Lead jarosite also known as plumbojarosite ($PbFe_6(SO_4)_4(OH)_{12}$) was identified in relation to jarosite in 1902 [5]. Plumbojarosite is often found in cationic mixed jarosites [6–9]. Such minerals are of importance in medieval and archaeological science [10, 11] and are also found in mine drainage sites both ancient and modern [9, 11, 12]. Such formation of jarosites has been occurring since the Bronze Age [13]. The importance of jarosite formation and its decomposition depends upon its presence in soils, sediments and evaporate deposits [14]. These types of deposits have formed in acid soils where the pH is less than 3.0 pH units [15]. Such acidification results from the oxidation of pyrite which may be from bacterial action or through air-oxidation.

The thermal decomposition of jarosites has been studied for some considerable time [16–20]. However no thermal

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