

## 机构登录

欢迎访问!

为了使用本网站的个性化功能,请

[登录](#)或[注册](#)

如果您忘记了您的用户名或密码,我们能[帮助](#).

## 个人资料

[标记条目](#)

[提醒](#)

[订购历史](#)

[全部收藏条目](#)

[珍藏条目](#)



Become a fan

## 期刊文章



### Thermogravimetric analysis and hot-stage Raman spectroscopy of cubic indium hydroxide

期刊	<a href="#">Journal of Thermal Analysis and Calorimetry</a>
出版社	Akadémiiai Kiadó, co-published with Springer Science+Business Media B.V., Formerly Kluwer Academic Publishers B.V.
ISSN	1388-6150 (Print) 1572-8943 (Online)
学科	<a href="#">Chemistry</a> , <a href="#">Sciences</a> , <a href="#">Polymer Sciences</a> , <a href="#">Physical Chemistry</a> , <a href="#">Inorganic Chemistry</a> , <a href="#">Measurement Science</a> , <a href="#">Instrumentation</a>
期	<a href="#">Volume 100, Number 1</a>
页	109-116
DOI	10.1007/s10973-009-0554-x
Subject Group	<a href="#">化学和材料科学</a>
在线日期	2009年10月31日

[PDF \(498.4 KB\)](#) [HTML](#) [First Page Preview](#)

作者

Jing Yang<sup>1</sup>, Ray L. Frost<sup>1</sup> , Wayne N. Martens<sup>1</sup>

<sup>1</sup>Queensland University of Technology Inorganic Materials Research Program, School of Physical and Chemical Sciences GPO Box 2434 Brisbane QLD 4001 Australia

摘要

Abstract

The transition of cubic indium hydroxide to cubic indium oxide has been studied by thermogravimetric analysis complimented with hot-stage Raman spectroscopy. Thermal analysis shows the transition of  $\text{In}(\text{OH})_3$  to  $\text{In}_2\text{O}_3$  occurs at 219 °C. The structure and morphology of  $\text{In}(\text{OH})_3$  synthesised using a soft chemical route at low temperatures was confirmed by X-ray diffraction and scanning electron microscopy. A topotactical relationship exists between the micro/nano-cubes of  $\text{In}(\text{OH})_3$  and  $\text{In}_2\text{O}_3$ . The Raman spectrum of  $\text{In}(\text{OH})_3$  is characterised by an intense sharp band at  $309\text{ cm}^{-1}$  attributed to  $\nu_1$   $\text{In}-\text{O}$  symmetric stretching mode, bands at  $1137$  and  $1155\text{ cm}^{-1}$  attributed to  $\text{In}-\text{OH}$   $\delta$  deformation modes, bands at  $3083$ ,  $3215$ ,  $3123$  and  $3262\text{ cm}^{-1}$  assigned to the OH stretching vibrations. Upon thermal treatment of  $\text{In}(\text{OH})_3$ , new Raman bands are observed at  $125$ ,  $295$ ,  $488$  and  $615\text{ cm}^{-1}$  attributed to  $\text{In}_2\text{O}_3$ . Changes in the structure of  $\text{In}(\text{OH})_3$  with thermal treatment is readily followed by hot-stage Raman spectroscopy.

Keywords

Thermogravimetry, Hot-stage Raman spectroscopy, Indium hydroxide, Indium oxide

[Fulltext Preview \(Small, \[Large\]\(#\)\)](#)

[添加入标记条目中](#)

[添加入收藏条目中](#)

[推荐此文章](#)

检索

[高级检索](#)

[提交](#)

在所有内容之内检索

在此期刊之内检索

在此期之内检索

输出此章节

[RIS](#) | [文本](#)

被引用文献

共 8 篇最新文献

1. Gurlo, Aleksander (2010) Pressure-Induced Decomposition of Indium Hydroxide. *Journal of the American Chemical Society* 132(36) [\[CrossRef\]](#)
2. Frost, Ray L. (2011) Thermal stability of stercorite  $\text{H}(\text{NH}_4)\text{Na}(\text{PO}_4) \cdot 4\text{H}_2\text{O}$ : A cave mineral from Petrogale Cave, Madura, Eucla, Western Australia. *Journal of Thermal Analysis and Calorimetry* [\[CrossRef\]](#)
3. Frost, Ray L. (2011) Thermal Stability of newberyite  $\text{Mg}(\text{PO}_3\text{OH}) \cdot 3\text{H}_2\text{O}$ : A cave mineral from Skipton Lava Tubes, Victoria, Australia. *Journal of Thermal Analysis and Calorimetry* [\[CrossRef\]](#)
4. Frost, Ray L. (2011) Thermal stability of crandallite  $\text{CaAl}_3$

## Thermogravimetric analysis and hot-stage Raman spectroscopy of cubic indium hydroxide

Jing Yang · Ray L. Frost · Wayne N. Martens

Received: 24 March 2009 / Accepted: 9 October 2009 / Published online: 1 November 2009  
© Akadémiai Kiadó, Budapest, Hungary 2009

**Abstract** The transition of cubic indium hydroxide to cubic indium oxide has been studied by thermogravimetric analysis complemented with hot-stage Raman spectroscopy. Thermal analysis shows the transition of  $\text{In}(\text{OH})_3$  to  $\text{In}_2\text{O}_3$  occurs at 219 °C. The structure and morphology of  $\text{In}(\text{OH})_3$  synthesised using a soft chemical route at low temperatures was confirmed by X-ray diffraction and scanning electron microscopy. A topotactical relationship exists between the micro/nano-cubes of  $\text{In}(\text{OH})_3$  and  $\text{In}_2\text{O}_3$ . The Raman spectrum of  $\text{In}(\text{OH})_3$  is characterised by an intense sharp band at  $309\text{ cm}^{-1}$  attributed to  $\nu_1$   $\text{In}-\text{O}$  symmetric stretching mode, bands at  $1137$  and  $1155\text{ cm}^{-1}$  attributed to  $\text{In}-\text{OH}$   $\delta$  deformation modes, bands at  $3083$ ,  $3215$ ,  $3123$  and  $3262\text{ cm}^{-1}$  assigned to the OH stretching vibrations. Upon thermal treatment of  $\text{In}(\text{OH})_3$ , new Raman bands are observed at  $125$ ,  $295$ ,  $488$  and  $615\text{ cm}^{-1}$  attributed to  $\text{In}_2\text{O}_3$ . Changes in the structure of  $\text{In}(\text{OH})_3$  with thermal treatment is readily followed by hot-stage Raman spectroscopy.

**Keywords** Thermogravimetry · Hot-stage Raman spectroscopy · Indium hydroxide · Indium oxide

### Introduction

Indium hydroxides and oxides are a series of important semiconductor materials, which have attracted much

attention in the last decade.  $\text{In}(\text{OH})_3$  is a wide-gap semiconductor with  $E_g = 5.15\text{ eV}$  [1], which has potential applications in photocatalytic, electronic, and solar energy fields [2–4]. While  $\text{In}_2\text{O}_3$  is known as n-type semiconductor with a direct band gap of  $3.6\text{ eV}$  (which is close to that of GaN [5]) and an indirect band gap of  $2.6\text{ eV}$  [6].  $\text{In}_2\text{O}_3$  has been used widely as solar cells, transparent conductors and sensors [7–11].

In recent years,  $\text{In}(\text{OH})_3$  and  $\text{In}_2\text{O}_3$  with various morphologies (e.g. nanowires [12], nanobelts [13], nanorods [14], nanotubes [15] and nanospheres [16], etc.) have been synthesised via different methods, such as chemical vapour deposition, hot-injection techniques, organic solution synthetic routes, hydrothermal methods, and solvothermal and others. It is known that cubic particles expose a specific surface, which provides an ideal model for the study of surface-related properties [17], and conversion of these cubic particles into microscale devices may provide scope for future applications. In particular, the production of indium hydroxide and indium oxide micro/nano-cubes has been realized up to now. There are several reports on synthesis of indium hydroxide micro/nano-cubes via hydrothermal routes [6, 17]. However, the characterisation on indium hydroxide and oxide micro/nano-cubes is not fully recorded yet, or appreciated, especially the thermal analysis and spectroscopic studies.

The underlying objective of this research is to synthesise an adequate indium oxide semiconductor [18–20]. The properties of these semiconductors depend very heavily on the synthesis method and preparation of the indium oxide [1, 21]. Therefore, the aim of this research is to demonstrate the use of thermal analysis and hot-stage Raman spectroscopy to assess the thermal stability of indium hydroxide, and to determine the changes in the molecular structure of the material when the indium hydroxide is

J. Yang · R. L. Frost (✉) · W. N. Martens  
Inorganic Materials Research Program, School of Physical  
and Chemical Sciences, Queensland University of Technology,  
GPO Box 2434, Brisbane, QLD 4001, Australia  
e-mail: r.frost@qut.edu.au

- ( $\text{PO}_4$ ) $_2$ ( $\text{OH}$ ) $_5 \cdot (\text{H}_2\text{O})$ : A ‘Cave’ mineral from the Jenolan Caves. *Journal of Thermal Analysis and Calorimetry* [CrossRef]
5. Park, Yuri (2011) A thermoanalytical assessment of an organoclay. *Journal of Thermal Analysis and Calorimetry* [CrossRef]
  6. Frost, Ray L. (2011) Thermal stability of the ‘cave’ mineral ardealite  $\text{Ca}_2(\text{HPO}_4)(\text{SO}_4) \cdot 4\text{H}_2\text{O}$ . *Journal of Thermal Analysis and Calorimetry* [CrossRef]
  7. Yang, Jing Jeanne (2010) Transition of synthetic chromium oxide gel to crystalline chromium oxide: a hot-stage Raman spectroscopic study. *Journal of Raman Spectroscopy* [CrossRef]
  8. Yang, Jing (2010) Size-controllable synthesis of chromium oxyhydroxide nanomaterials using a soft chemical hydrothermal route. *Journal of Materials Science* [CrossRef]



AKADÉMIAI KIADÓ

## Akadémiai Kiadó

H-1519 Budapest, Pf. 245

Telephone: +36-1-464-8222

email: [journals@akkt.hu](mailto:journals@akkt.hu)

© Akadémiai Kiadó Zrt.

[online dictionary / online szótár](#)

[5th European Conference of the International Federation for Medical and Biological Engineering](#)

[Frontiers in Organic Synthesis Technology 3. - FROST 3](#)

Remote Address: 122.70.132.162 • Server: MPSHQWBRDR03P

HTTP User Agent: Mozilla/4.0 (compatible; MSIE 6.0; Windows NT 5.2; SV1; .NET CLR 1.1.4322; .NET CLR 2.0.50727; .NET CLR 3.0.4506.2152; .NET CLR 3.5.30729)