

119

Structure and Bonding

Series Editor: D. M. P. Mingos

Editorial Board:

P. Day · T. J. Meyer · H. W. Roesky · J.-P. Sauvage

Structure and Bonding

Series Editor: D. M. P. Mingos

Recently Published and Forthcoming Volumes

Layered Double Hydroxides

Volume Editors: Duan, X., Evans, D. G.
Vol. 119, 2005

Semiconductor Nanocrystals and Silicate Nanoparticles

Volume Editors: Peng, X., Mingos, D. M. P.
Vol. 118, 2005

Magnetic Functions Beyond the Spin-Hamiltonian

Volume Editor: Mingos, D. M. P.
Vol. 117, 2005

Intermolecular Forces and Clusters II

Volume Editor: Wales, D. J.
Vol. 116, 2005

Intermolecular Forces and Clusters I

Volume Editor: Wales, D. J.
Vol. 115, 2005

Superconductivity in Complex Systems

Volume Editor: Müller, K. A.
Vol. 114, 2005

Principles and Applications of Density Functional Theory in Inorganic Chemistry II

Volume Editors:
Kaltsoyannis, N., McGrady, J. E.
Vol. 113, 2004

Principles and Applications of Density Functional Theory in Inorganic Chemistry I

Volume Editors:
Kaltsoyannis, N., McGrady, J. E.
Vol. 112, 2004

Supramolecular Assembly via Hydrogen Bonds II

Volume Editor: Mingos, D. M. P.
Vol. 111, 2004

Applications of Evolutionary Computation in Chemistry

Volume Editors: Johnston, R. L.
Vol. 110, 2004

Fullerene-Based Materials

Structures and Properties
Volume Editor: Prassides, K.
Vol. 109, 2004

Supramolecular Assembly via Hydrogen Bonds I

Volume Editor: Mingos, D. M. P.
Vol. 108, 2004

Optical Spectra and Chemical Bonding in Transition Metal Complexes

**Special Volume II
dedicated to Professor Jørgensen**
Volume Editor: Schönherr, T.
Vol. 107, 2004

Optical Spectra and Chemical Bonding in Inorganic Compounds

**Special Volume I
dedicated to Professor Jørgensen**
Volume Editor: Schönherr, T.
Vol. 106, 2004

Group 13 Chemistry III Industrial Applications

Volume Editors: Roesky, H. W., Atwood, D. A.
Vol. 105, 2003

Layered Double Hydroxides

Volume Editors: X. Duan, D. G. Evans

With contributions by

X. Duan · D. G. Evans · J. He · Y. Kang · A. I. Khan

F. Leroux · B. Li · F. Li · D. O'Hare · R. C. T. Slade

C. Taviot-Gueho · M. Wei · G. R. Williams

The series *Structure and Bonding* publishes critical reviews on topics of research concerned with chemical structure and bonding. The scope of the series spans the entire Periodic Table. It focuses attention on new and developing areas of modern structural and theoretical chemistry such as nanostructures, molecular electronics, designed molecular solids, surfaces, metal clusters and supra-molecular structures. Physical and spectroscopic techniques used to determine, examine and model structures fall within the purview of *Structure and Bonding* to the extent that the focus is on the scientific results obtained and not on specialist information concerning the techniques themselves. Issues associated with the development of bonding models and generalizations that illuminate the reactivity pathways and rates of chemical processes are also relevant.

As a rule, contributions are specially commissioned. The editors and publishers will, however, always be pleased to receive suggestions and supplementary information. Papers are accepted for *Structure and Bonding* in English.

In references *Structure and Bonding* is abbreviated *Struct Bond* and is cited as a journal.

Springer WWW home page: <http://www.springer.com>

Visit the SAB content at <http://www.springerlink.com/>

Library of Congress Control Number: 2005930165

ISSN 0081-5993

ISBN-10 3-540-28279-3 Springer Berlin Heidelberg New York

ISBN-13 978-3-540-28279-2 Springer Berlin Heidelberg New York

DOI 10.1007/b100426

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilm or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable for prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media

springer.com

© Springer-Verlag Berlin Heidelberg 2006

Printed in Germany

The use of registered names, trademarks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

Cover design: *Design & Production* GmbH, Heidelberg

Typesetting and Production: LE-TeX Jelonek, Schmidt & Vöckler GbR, Leipzig

Printed on acid-free paper 02/3141 YL - 5 4 3 2 1 0

Series Editor

Prof. D. Michael P. Mingos

Principal
St. Edmund Hall
Oxford OX1 4AR, UK
michael.mingos@st-edmund-hall.oxford.ac.uk

Volume Editors

Prof. David G. Evans

Ministry of Education
Key Laboratory of Science and Technology
of Controllable Chemical Reactions
P.O. Box 98
Beijing University of Chemical Technology
Beijing 100029, P.R. China
dgevens@mail.buct.edu.cn

Prof. Xue Duan

Ministry of Education
Key Laboratory of Science and Technology
of Controllable Chemical Reaction
P.O. Box 98
Beijing University of Chemical Technology
Beijing 100029, P.R. China
duanx@mail.buct.edu.cn

Editorial Board

Prof. Peter Day

Director and Fulleren Professor
of Chemistry
The Royal Institution of Great Britain
21 Albermarle Street
London W1X 4BS, UK
pday@ri.ac.uk

Prof. Herbert W. Roesky

Institut for Anorganic Chemistry
University of Göttingen
Tammannstr. 4
37077 Göttingen, Germany
hroesky@gwdg.de

Prof. Thomas J. Meyer

Department of Chemistry
Campus Box 3290
Venable and Kenan Laboratories
The University of North Carolina
and Chapel Hill
Chapel Hill, NC 27599-3290, USA
tjmeyer@unc.edu

Prof. Jean-Pierre Sauvage

Faculté de Chimie
Laboratoires de Chimie
Organo-Minérale
Université Louis Pasteur
4, rue Blaise Pascal
67070 Strasbourg Cedex, France
sauvage@chimie.u-strasbg.fr

Structure and Bonding

Also Available Electronically

For all customers who have a standing order to Structure and Bonding, we offer the electronic version via SpringerLink free of charge. Please contact your librarian who can receive a password or free access to the full articles by registering at:

springerlink.com

If you do not have a subscription, you can still view the tables of contents of the volumes and the abstract of each article by going to the SpringerLink Homepage, clicking on "Browse by Online Libraries", then "Chemical Sciences", and finally choose Structure and Bonding.

You will find information about the

- Editorial Board
- Aims and Scope
- Instructions for Authors
- Sample Contribution

at springeronline.com using the search function.

Preface

Intercalation in layered solids is a long-established phenomenon. It has been suggested [1] that the first example, dating from over two thousand years ago, involved intercalation in kaolinite (an aluminosilicate clay) and explains the secret behind the production of fine Chinese porcelain. In modern times, many thousands of papers have been devoted to intercalation chemistry in clays, graphite and other materials.

In this volume, various aspects of the chemistry of layered double hydroxides (LDHs) are reviewed. LDHs are a class of synthetic anionic clays whose structure is based on brucite ($\text{Mg}(\text{OH})_2$)-like layers in which some of the divalent cations have been replaced by trivalent ions giving positively-charged sheets. This charge is balanced by intercalation of anions in the hydrated interlayer regions. The identities and ratios of the di- and trivalent cations and the interlayer anion may be varied over a wide range, giving rise to a large class of isostructural materials. The parent material of this class is the naturally occurring mineral hydrotalcite and LDHs are consequently also known as hydrotalcite-like materials. Although the basic features of the structure are well understood, detailed structural aspects have been the subject of some controversy in the literature. In the first chapter of this volume, Evans and Slade review the wide range of experimental and theoretical studies in this area, highlighting areas of consensus and currently unresolved issues.

Although simple to prepare in the laboratory in principle, LDHs are not always easy to synthesize as pure phases. In the second chapter of this volume He et al. review methods of synthesis of LDHs, with an emphasis on the way in which the physicochemical properties of the materials vary with the synthesis method.

In the following chapter, Taviot-Guého and Leroux review the synthesis and structural features of nanocomposite materials prepared by the assembly of LDHs and polymers or polymer precursors and discuss how the properties of the resulting hybrid materials are related to their structure.

Although a great many intercalation compounds of LDHs have been prepared and characterized, there have been few studies of the kinetics and mechanism of the intercalation process. In their chapter, O'Hare and colleagues describe how detailed information about these aspects may be obtained by means of time-resolved in situ X-ray powder diffraction experiments.

The wide range of possible compositions of LDHs means that materials with a great variety of different properties can be produced. A detailed understanding of the structural chemistry of LDHs as well as the kinetics and mechanism of the formation process should facilitate the design of materials with properties precisely tailored for specific applications. In the final chapter of this volume, Li and Duan review current and potential applications of LDHs in this light.

In recent years, there has been an explosive growth in publications concerning LDHs in both academic journals and the patent literature. These reviews have attempted to cover work published up to early 2005, but many examples of excellent science have no doubt been excluded, either inadvertently or because of space limitations.

Beijing, October 2005

X. Duan, D. G. Evans

Reference

1. Weiss A (1963) *Angew Chem* 75:755; *Angew Chem Int Ed Engl* 2:697

Contents

Structural Aspects of Layered Double Hydroxides D. G. Evans · R. C. T. Slade	1
Preparation of Layered Double Hydroxides J. He · M. Wei · B. Li · Y. Kang · D. G Evans · X. Duan	89
In Situ Polymerization and Intercalation of Polymers in Layered Double Hydroxides C. Taviot-Gueho · F. Leroux	121
Mechanistic and Kinetic Studies of Guest Ion Intercalation into Layered Double Hydroxides Using Time-Resolved, In-situ X-ray Powder Diffraction G. R. Williams · A. I. Khan · D. O'Hare	161
Applications of Layered Double Hydroxides F. Li · X. Duan	193
Author Index Volumes 101–119	225
Subject Index	233

Contents of Volume 118

Semiconductor Nanocrystals and Silicate Nanoparticles

ISBN: 3-540-27805-2

Electrochemistry and Electrogenerated Chemiluminescence of Semiconductor Nanocrystals in Solutions and in Films

A. J. Bard · Z. Ding · N. Myung

Intraband Spectroscopy and Semiconductor Nanocrystals

P. Guyot-Sionnest

Controlled Synthesis of High Quality Semiconductor Nanocrystals

X. Peng · J. Thessing

The Zintl–Klemm Concept Applied to Cations in Oxides.

II. The Structures of Silicates

D. Santamaría-Pérez · A. Vegas · F. Liebau