

Chem Soc Rev

Chemical Society Reviews

www.rsc.org/chemsocrev

RSC Publishing is a not-for-profit publisher and a division of the Royal Society of Chemistry. Any surplus made is used to support charitable activities aimed at advancing the chemical sciences. Full details are available from www.rsc.org

IN THIS ISSUE

ISSN 0306-0012 CODEN CSRVBR 35(10) 845-1016 (2006)



Cover

Chemistry at high pressures. Background image - a newly-determined structure for an "elemental alloy" obtained at high pressure. Foreground image - high pressure effects on protein folding mechanisms. Images reproduced by permission of Filip Meersman *et al.* p. 908 and M. Santoro and F. A. Gorelli, p. 918.

CHEMICAL SCIENCE

C73

Drawing together the research highlights and news from all RSC publications, *Chemical Science* provides a 'snapshot' of the latest developments across the chemical sciences showcasing newsworthy articles, as well as the most significant scientific advances.

Chemical Science

October 2006/Volume 3/Issue 10

www.rsc.org/chemicalscience

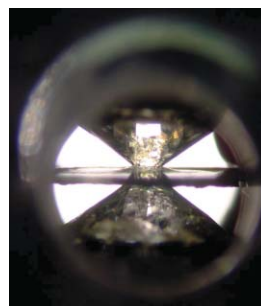
EDITORIAL

855

Chemistry at high pressure

Paul F. McMillan

Guest Editor Professor Paul McMillan discusses modern high pressure research and introduces the reviews and authors in this special issue of *Chemical Society Reviews* on Chemistry at High Pressure.



EDITORIAL STAFF

Editor

Robert Eagling

Publishing assistant

Natalie Ford

Team leader, serials production

Helen Saxton

Technical editors

Sandra Jones, Ken Wilkinson

Administration coordinator

Sonya Spring

Production secretaries

Lynne Braybrook, Jill Segev, Julie Thompson

Publisher

Janet Dean

Chemical Society Reviews (print: ISSN 0306-0012; electronic: ISSN 1460-4744) is published 12 times a year by the Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, UK CB4 0WF.

All orders, with cheques made payable to the Royal Society of Chemistry, should be sent to RSC Distribution Services, c/o Portland Customer Services, Commerce Way, Colchester, Essex, UK CO2 8HP. Tel +44 (0) 1206 226050; Email sales@rscdistribution.org

2006 Annual (print + electronic) subscription price: £454; US\$831. 2006 Annual (electronic) subscription price: £409; US\$748. Customers in Canada will be subject to a surcharge to cover GST. Customers in the EU subscribing to the electronic version only will be charged VAT.

If you take an institutional subscription to any RSC journal you are entitled to free, site-wide web access to that journal. You can arrange access via Internet Protocol (IP) address at www.rsc.org/ip. Customers should make payments by cheque in sterling payable on a UK clearing bank or in US dollars payable on a US clearing bank. Periodicals postage paid at Rahway, NJ, USA and at additional mailing offices. Airfreight and mailing in the USA by Mercury Airfreight International Ltd., 365 Blair Road, Avenel, NJ 07001, USA.

US Postmaster: send address changes to: Chemical Society Reviews, c/o Mercury Airfreight International Ltd., 365 Blair Road, Avenel, NJ 07001. All dispatches outside the UK by Consolidated Airfreight.

PRINTED IN THE UK

Advertisement sales: Tel +44 (0) 1223 432243; Fax +44 (0) 1223 426017; E-mail advertising@rsc.org

Chem Soc Rev

Chemical Society Reviews

www.rsc.org/chemsocrev

Chemical Society Reviews publishes accessible, succinct and reader-friendly articles on topics of current interest in the chemical sciences. The promotion of international and multidisciplinary awareness and cooperation is particularly encouraged. Chemical Society Reviews publishes two article types: tutorial reviews, which present an accessible introduction to the topic, and critical reviews, which provide a deeper evaluation of the current literature.

EDITORIAL BOARD

Chair

David Parker, Durham
david.parker@durham.ac.uk
Fabio Biscarini, Bologna
f.biscarini@ism.bo.cnr.it
Carsten Bolm, Aachen
carsten.bolm@oc.rwth-Aachen.de
Joseph Caruso, Cincinnati
joseph.caruso@uc.edu
Luisa de Cola, Muenster
decola@uni-muenster.de
Huw Davies, Buffalo, US
hdavies@acsu.buffalo.edu
John de Mello, London
j.demello@imperial.ac.uk
Odile Eisenstein, Montpellier
odile.eisenstein@univ-montp2.fr
Phil Gale, Southampton
philip.gale@soton.ac.uk

Kenneth D. M. Harris, Cardiff
harriskdm@cardiff.ac.uk
Wilhelm Huck, Cambridge
wtsh2@cam.ac.uk
George Marston, Reading
g.marston@reading.ac.uk
Chris Orvig, Vancouver
orvig@chem.ubc.ca
Jon Preece, Birmingham
j.a.preece@bham.ac.uk
David Spring, Cambridge
drspring@ch.cam.ac.uk
Claudio Zannoni, Bologna
claudio.zannoni@unibo.it
Adriano Zecchina, Turin
adriano.zecchina@unito.it

INTERNATIONAL ADVISORY EDITORIAL BOARD

Pat Bailey, Manchester, UK
p.bailey@umist.ac.uk
Nicolai Bovin, Moscow, Russia
bovin@carb.ibch.ru
Bertrand Castro, Gentilly
Bertrand.Castro@sanofi-synthelabo.com
George Christou, Gainesville, US
christou@chem.ufl.edu
Li-Xin Dai, Shanghai, China
dailx@mail.sioc.ac.cn
Anne Dell, London
a.dell@ic.ac.uk
Sam Gellman, Madison, US
gellman@chem.wisc.edu
Dirk Guldí, Erlangen, Germany
dirk.guldí@chemie.uni-erlangen.de

James T. Hynes, Boulder, US and Paris, France
hynes@spot.colorado.edu and hynes@junie.ens.fr
Masahiro Irie, Fukuoka, Japan
irie@cstf.kyushu-u.ac.jp
Ari Koskinen, Helsinki, Finland
ari.koskinen@hut.fi
Milan Mrksich, Chicago, US
mmrksich@uchicago.edu
C.N.R. Rao, Bangalore, India
cnrrao@jncasr.ac.in
Ezio Rizzardo, Victoria, Australia
ezio.rizzardo@csiro.au
Abraham Shanzer, Rehovot, Israel
abraham.shanzer@weizmann.ac.il

INFORMATION FOR AUTHORS

The Editorial Board commissions articles that encourage international, interdisciplinary progress in chemical research. The Board welcomes proposals for new tutorial reviews or critical reviews and the appropriate synopsis pro forma should be requested from the Editorial Office (cscr@rsc.org). Full details of how to submit material for publication in Chemical Society Reviews are given in the Instructions for Authors (available from <http://www.rsc.org/authors>). Submissions should be sent via ReSource: <http://www.rsc.org/resource>

Authors may reproduce/republish portions of their published contribution without seeking permission from the RSC, provided that any such republication is accompanied by an acknowledgement in the form: (Original Citation) – Reproduced by permission of The Royal Society of Chemistry.

© The Royal Society of Chemistry 2006. Apart from fair dealing for the purposes of research

or private study for non-commercial purposes, or criticism or review, as permitted under the Copyright, Designs and Patents Act 1988 and the Copyright and Related Rights Regulation 2003, this publication may only be reproduced, stored or transmitted, in any form or by any means, with the prior permission in writing of the Publishers or in the case of reprographic reproduction in accordance with the terms of licences issued by the Copyright Licensing Agency in the UK. US copyright law is applicable to users in the USA.

The Royal Society of Chemistry takes reasonable care in the preparation of this publication but does not accept liability for the consequences of any errors or omissions.

Ⓢ The paper used in this publication meets the requirements of ANSI/NISO Z39.48-1992 (Permanence of Paper).

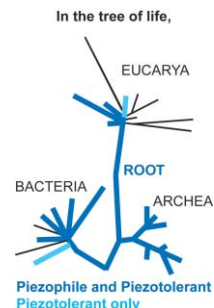
Royal Society of Chemistry: Registered Charity No. 207890.

858

Origins of life and biochemistry under high-pressure conditions

Isabelle Daniel, Philippe Oger and Roland Winter

After a short introduction to the early Earth history and environment, this tutorial review presents biological and physico-chemical arguments in support of a high-pressure origin for life on Earth.

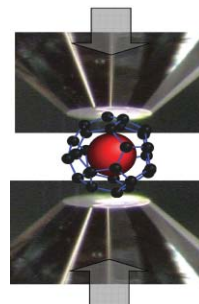


876

Nanomaterials under high-pressure

Alfonso San-Miguel

Nanomaterials submitted to high pressure conditions can reveal new thermodynamics as well as novel routes for the synthesis of materials.

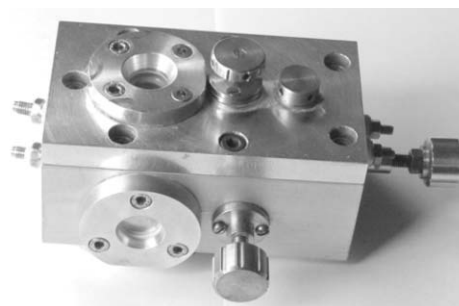


890

High pressure effects in anaesthesia and narcosis

Agnieszka Włodarczyk,* Paul F. McMillan and Susan A. Greenfield

There is growing interest in determining the effects of high pressure on biological functions. This *tutorial review* reviews the current state of knowledge of hyperbaric effects on brain processes.



899

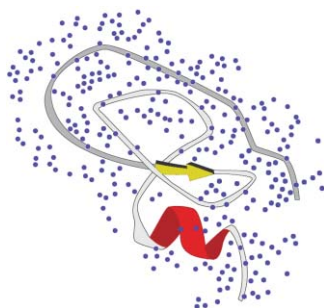
Probing hydrogen-rich molecular systems at high pressures and temperatures

Alexander F. Goncharov and Russell J. Hemley

New studies of hydrogen-rich molecular solids and fluids at high densities provide new information on effective potentials, molecular dissociation, ionization, polymerization, quantum effects, and order-disorder phenomena.



908

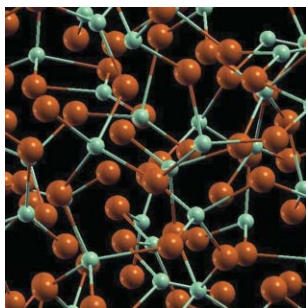


Protein unfolding, amyloid fibril formation and configurational energy landscapes under high pressure conditions

Filip Meersman,* Christopher M. Dobson and Karel Heremans

High hydrostatic pressure as a perturbation tool to probe packing and hydration of proteins and protein assemblies.

918

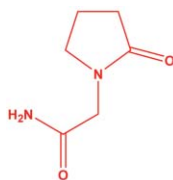


High pressure solid state chemistry of carbon dioxide

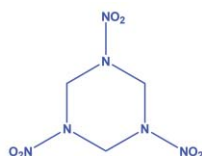
M. Santoro and F. A. Gorelli

High pressure leads to synthesize unusual solid materials such as α -carbonia (α -CO₂), *e.g.* the amorphous silica-like carbon dioxide (cyan: carbon, red: oxygen).

932



Piracetam



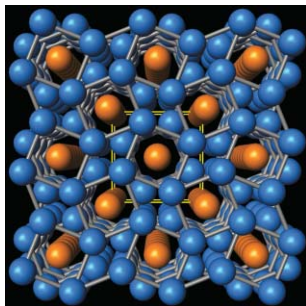
RDX

High-pressure studies of pharmaceutical compounds and energetic materials

Francesca P. A. Fabbiani and Colin R. Pulham*

Pharmaceuticals and explosives under pressure—new crystal structures leading to changes in properties and performance.

943



High-pressure structures and phase transformations in elemental metals

Malcolm I. McMahon and Richard J. Nelmes

The metallic elements adopt a variety of remarkably complex crystal structures when subjected to high pressures; the graphic shows the incommensurate composite structure adopted by rubidium above 17 GPa, comprising a 'host' framework (blue) and 'guest' chains (gold) that lie in channels through the host structure.

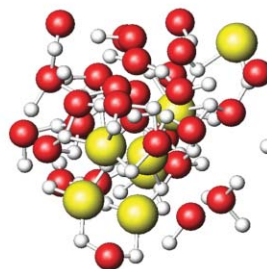
964

Structural studies and polymorphism in amorphous solids and liquids at high pressure

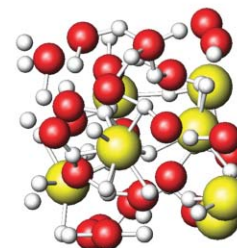
Martin C. Wilding, Mark Wilson and Paul F. McMillan

Amorphous materials may form distinct structures which differ in density and between which the phase transformations may show first order character.

High-density form



Low-density form

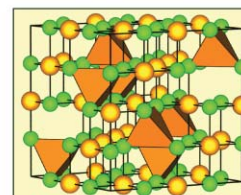
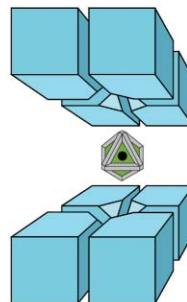


987

High-pressure chemistry of nitride-based materials

Elisabeta Horvath-Bordon,* Ralf Riedel,* Andreas Zerr,* Paul F. McMillan,* Gudrun Auffermann, Yurii Prots, Welf Bronger, Rüdiger Knip* and Peter Kroll*

Recent developments that utilize high pressures and high-temperatures for the synthesis of new materials with unique properties, such as high hardness, or interesting magnetic or optoelectronic features are reviewed. Novel metal nitrides, oxonitrides, as well as the new class of nitride-diazenide compounds, all formed under high-pressure conditions, are highlighted. Pure oxides and carbides are not considered here.



FREE E-MAIL ALERTS AND RSS FEEDS


Contents lists in advance of publication are available on the web *via* www.rsc.org/chemsocrev - or take advantage of our free e-mail alerting service (www.rsc.org/ej_alert) to receive notification each time a new list becomes available.

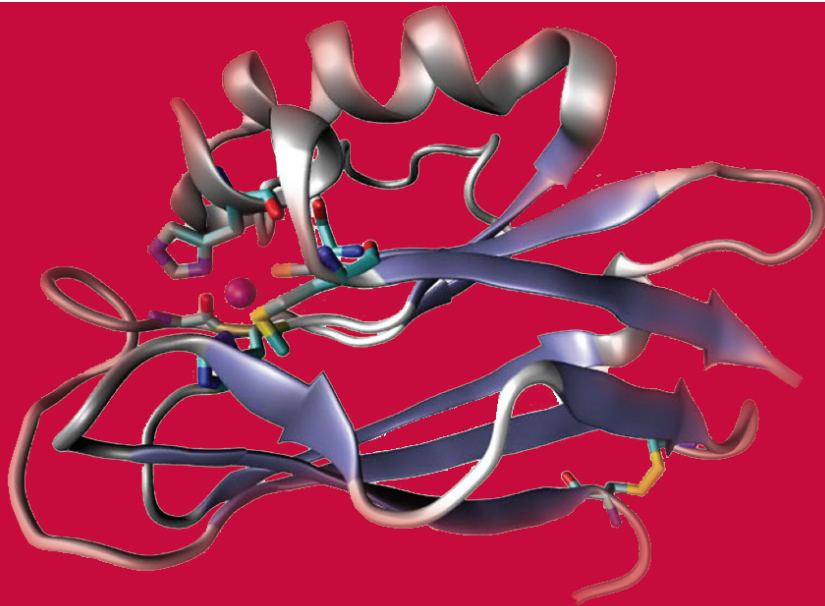
RSS Try our RSS feeds for up-to-the-minute news of the latest research. By setting up RSS feeds, preferably using feed reader software, you can be alerted to the latest Advance Articles published on the RSC web site. Visit www.rsc.org/publishing/technology/rss.asp for details.

ADVANCE ARTICLES AND ELECTRONIC JOURNAL

Free site-wide access to Advance Articles and the electronic form of this journal is provided with a full-rate institutional subscription. See www.rsc.org/ejs for more information.

* Indicates the author for correspondence: see article for details.

 Electronic supplementary information (ESI) is available *via* the online article (see <http://www.rsc.org/esi> for general information about ESI).



Included in MEDLINE®

Rated #1 for Immediacy Index

Publication in as little as 9 days

PCCP Bio: Expanding biology through biophysical chemistry

PCCP – *Physical Chemistry Chemical Physics* showcases the very best research in biophysical chemistry, publishing results that elucidate the physical chemistry of biological macromolecules and the theoretical and experimental techniques used to study them. With superb publication times, the highest immediacy index in its category* and all papers appearing in MEDLINE® and ISI Web of Science®, PCCP is the home of the best in biophysical chemistry.

A selection of recent papers:

Biosensing with conically shaped nanopores and nanotubes

Y. Choi *et al.*, *Phys. Chem. Chem. Phys.*, 2006

DOI: 10.1039/b607360c

Unravelling single metalloprotein electron transfer by scanning probe techniques

A. Alessandrini *et al.*, *Phys. Chem. Chem. Phys.*, 2006

DOI: 10.1039/b607021c

Molecular mechanisms of cellular mechanics

M. Gao *et al.*, *Phys. Chem. Chem. Phys.*, 2006, **8**, 3692

Energy transfer in photosynthesis: experimental insights and quantitative models

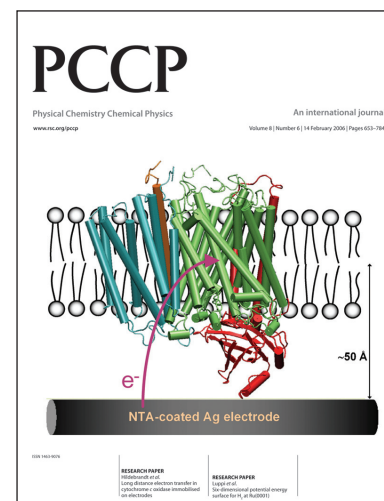
R. van Grondelle and V. I. Novoderezhkin, *Phys. Chem. Chem. Phys.*, 2006, **8**, 793

Structure of a β -sheet model system in the gas phase: Analysis of the fingerprint region up to 10 μm

H. Fricke *et al.*, *Phys. Chem. Chem. Phys.*, 2006, **8**, 1660

Submit your manuscript at www.rsc.org/ReSource and visit the website to read the latest biophysical research.

* According to the 2005 Journal Citation Reports® PCCP's Immediacy Index of 0.762 is the highest value for any general journal publishing primary research in the fields of physical chemistry or chemical physics. The journal immediacy index indicates how quickly articles in a journal are cited. For comparing journals specializing in cutting-edge research, the immediacy index can provide a useful perspective.



Registered Charity Number: 207890

RSC Publishing

www.rsc.org/pccpbio

Lust and Love

Is it more than chemistry?

By Gabriele and Rolf Froböse

Why do people fall in love?

Why do we find some people attractive?

**How does our physiology affect
the way we feel?**



07080631

Lust and Love: Is it more than chemistry? provides answers to some of these questions through the eyes of science. Covering research from the fields of chemistry, biochemistry, neurology, psychiatry, psychology, physics and medicine the book looks at our current knowledge of the science behind these feelings.

Explores the science behind love, sex and passion

Hardback | 2006 | xii + 170 pages | £24.95 | RSC Member Price £16.50 | ISBN 10: 0 85404 867 7
ISBN 13: 978 0 85404 867 0



RSC Publishing

www.rsc.org/lustandlove

Environmental Science Books

Issues in Environmental Science & Technology

Series Editors:

R E Hester and R M Harrison

Format: **Hardback**

Price: **£45.00**

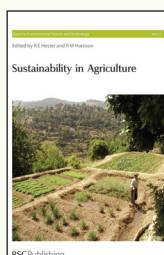
RSC Member Price: **£29.25**

Written by leading experts, this series presents a multidisciplinary approach to pollution and the environment. Focussing on the science and broader issues including economic, legal and political considerations.

Sustainability in Agriculture Vol. No. 21

Discusses the key factors impacting on global agricultural practices including fair trade, the use of pesticides, GM products and government policy.

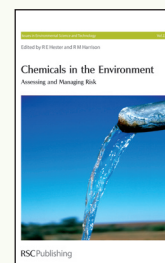
2005 | xiv+130 pages | ISBN-10: 0 85404 201 6
ISBN-13: 978 0 85404 201 2



Chemicals in the Environment Assessing and Managing Risk Vol. No. 22

Beginning with a review of the current legislation, the book goes on to discuss scientific and technical issues relating to chemicals in the environment and future developments.

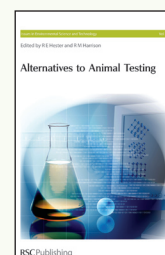
2006 | xvi+158 pages | ISBN-10: 0 85404 206 7
ISBN-13: 978 0 85404 206 7



Alternatives to Animal Testing Vol. No. 23

Provides an up-to-date discussion on the development of alternatives to animal testing including; international validation, safety evaluation, alternative tests and the regulatory framework.

2006 | xii+118 pages | ISBN-10: 0 85404 211 3
ISBN-13: 978 0 85404 211 1



Practical Environmental Analysis 2nd Edition

By *M Radojevic and V N Bashkin*

A new edition textbook providing an up-to-date guide to practical environmental analysis. Ideal for students and technicians as well as lecturers wishing to teach the subject.

Hardback | 2006 | xxiv+458 pages | £39.95 | RSC member price
£25.75 | ISBN-10: 0 85404 679 8 | ISBN-13: 978 0 85404 679 9



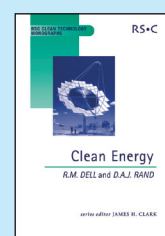
Clean Energy (RSC Clean Technology Monographs)

By *R M Dell and D A J Rand*

Series Editor *J H Clark*

Covering a broad spectrum of energy problems, this highly accessible book discusses in detail strategies for the world's future energy supply.

Hardback | 2004 | xxxvi+322 pages | £89.95 | RSC Member Price
£58.25 | ISBN-10: 0 85404 546 5 | ISBN-13: 978 0 85404 546 4

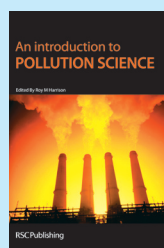


An Introduction to Pollution Science

By *R M Harrison*

A student textbook looking at pollution and its impact on human health and the environment. Covering a wide range of topics including pollution in the atmosphere, water and soil, and strategies for pollution management.

Hardback | 2006 | ca xii+322 pages | £24.95 | RSC Member Price
£16.50 | ISBN-10: 0 85404 829 4 | ISBN-13: 978 0 85404 829 8



Water Contamination Emergencies Enhancing Our Response

By *J Gray and K C Thompson*

A look at the impact and response of contaminated water supplies including the threat of chemical, biological, radiological and nuclear (CBRN) events.

Hardback | 2006 | x+372 pages | £99.95 | RSC Member Price
£64.75 | ISBN-10: 0 85404 658 5 | ISBN-13: 978 0 85404 658 4

