

Journal of Materials Chemistry C

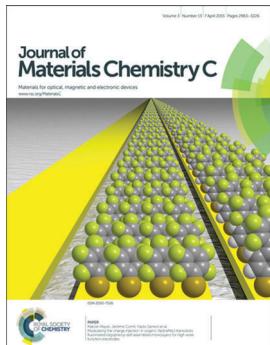
Materials for optical, magnetic and electronic devices

www.rsc.org/MaterialsC

The Royal Society of Chemistry is the world's leading chemistry community. Through our high impact journals and publications we connect the world with the chemical sciences and invest the profits back into the chemistry community.

IN THIS ISSUE

ISSN 2050-7526 CODEN JMCCCX 3(13) 2963–3226 (2015)



Cover

See Marcel Mayor,
Jérôme Cornil,
Paolo Samori et al.,
pp. 3007–3015.
Image reproduced
by permission of
Paolo Samori from
J. Mater. Chem. C,
2015, 3, 3007.

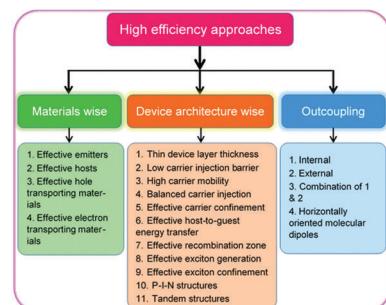
REVIEW

2974

Approaches for fabricating high efficiency organic light emitting diodes

Jwo-Huei Jou,* Sudhir Kumar, Abhishek Agrawal,
Tsung-Han Li and Snehashis Sahoo

Highly efficient OLEDs are extremely demanded for the design of highly competitive energy-saving displays and lightings. In this article, we have systematically reviewed some most effective organic materials, eleven device architectural approaches, and outcoupling techniques to realize the high efficiency OLEDs.



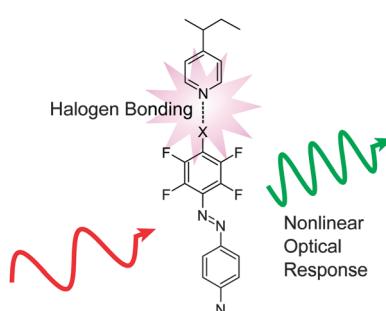
COMMUNICATION

3003

Halogen bonding enhances nonlinear optical response in poled supramolecular polymers

Matti Virkki, Ossi Tuominen, Alessandra Forni,
Marco Saccone, Pierangelo Metrangolo,
Giuseppe Resnati, Martti Kauranen and Arri Priimagi*

We demonstrate that halogen bonding strongly enhances the nonlinear optical response of poled supramolecular polymer systems.



Editorial staff**Executive editor**

Fiona McKenzie

Editorial production manager

Will Dennis

Deputy editor

Sam Keltie

Development editor

Sarah Thirkell

Publishing editors

Polly-Anna Ashford, Emma Cooper, Lyn Jennings, Carole Martin, Emma Stephen, Polly Wilson, Jason Woolford, Ruth Zadik

Publishing assistants

Aliya Anwar, Emily Finney, Julie Ann Roszkowski

Publisher

Liz Dunn

For queries about submitted papers, please contact Will Dennis, Editorial production manager in the first instance. E-mail: materialsC@rsc.org

For pre-submission queries please contact Fiona McKenzie, Executive editor.

E-mail: materialsC-rsc@rsc.org

Journal of Materials Chemistry C (print: ISSN 2050-7526; electronic: ISSN 2050-7534) is published 48 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 Order Department, Royal Society of Chemistry, Thomas Graham House, Science Park, Milton Road, Cambridge, CB4 0WF, UK.
Tel +44 (0)1223 432398 E-mail orders@rsc.org

2015 Annual (print+electronic) subscription price: £1747; \$2970. 2015 Annual (electronic) subscription price: £1660; \$2822. 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 Royal Society of Chemistry 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.

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. Inclusion of an item in this publication does not imply endorsement by The Royal Society of Chemistry of the content of the original documents to which that item refers.

Advertisement sales: Tel +44 (0) 1223 432246; Fax +44 (0) 1223 426017;
E-mail advertising@rsc.org

For marketing opportunities relating to this journal, contact marketing@rsc.org

Journal of Materials Chemistry C

www.rsc.org/materialsC

Journal of Materials Chemistry C is a weekly journal in the materials field. The journal is interdisciplinary, publishing work of international significance on all aspects of materials chemistry related to optical, magnetic and electronic devices. Articles cover the fabrication, properties and applications of materials.

Editorial board

Editor-in-Chief

Dongyuan Zhao, Fudan University, China

Deputy Editor-in-Chief

Peter Skabar, WestCHEM, University of Strathclyde, UK

Associate editors

Gitti Frey, Technion - Israel Institute of Technology, Israel

Justin Holmes, University College Cork, Ireland

Luis Hueso, CIC nanoGUNE, Spain

Malika Jeffries-EL, Iowa State University, USA

Neil Robertson, University of Edinburgh, UK

Federico Rosei, INRS (University of Quebec), Canada

Natalie Stingelin, Imperial College London, UK

Wai-Yeung Wong, Hong Kong Baptist University, Hong Kong

Yadong Yin, UC Riverside, USA

Xiaowei Zhan, Peking University, China

Advisory board

K. Awaga, Nagoya University, Japan

C. Bai, Chinese Academy of Sciences, China

E. Bittner, University of Houston, USA

T. Bunning, Air Force Research Laboratory, USA

K. Carter, University of Massachusetts – Amherst, USA

M. Chhowalla, Rutgers - The State University of New Jersey, USA

L.-L. Chua, National University of Singapore, Singapore

D. Evans, Beijing University of Chemical Technology, China

M. Green, King's College London, UK

J. Huang, Hong Kong Polytechnic University, Hong Kong

C. S. Hwang, Seoul National University, Korea

M. Kanatzidis, Northwestern University, USA

T. Kato, The University of Tokyo, Japan

J. Kido, Yamagata University, Japan

S.-W. Kim, Ajou University, Korea

S. Marder, Georgia Institute of Technology, USA

P. Meredith, University of Queensland, Australia

H. Nishihara, University of Tokyo, Japan

J. Ouyang, National University of Singapore, Singapore

P. Reiss, CEA Grenoble INAC/SPrAM, France

G. Rumbles, National Renewable Energy Laboratory, USA

P. Samori, Université de Strasbourg, France

R. Seshadri, University of California,

Santa Barbara, USA

Z. Shuai, Tsinghua University, China

C. Silva, University of Montreal, Canada

J. Snyder, California Institute of Technology, USA

C. Weder, University of Fribourg, Switzerland

P. Woodward, Ohio State University, USA

A. Zayats, Kings College London, UK

Information for authors

Full details on how to submit material for publication in Journal of Materials Chemistry C are given in the Instructions for Authors (available from <http://www.rsc.org/authors>). Submissions should be made via the journal's homepage: <http://www.rsc.org/materialsC>.

Submissions: The journal welcomes submissions of manuscripts for publication as Full Papers, Communications, Reviews, Highlights and Applications. Full Papers and Communications should describe original work of high quality and impact which must highlight the novel properties or applications (or potential properties/applications) of the materials studied.

Colour figures are reproduced free of charge. Additional details are available from the Editorial Office or <http://www.rsc.org/authors>

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

This journal is ©The Royal Society of Chemistry 2015. 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 paper used in this publication meets the requirements of ANSI/NISO Z39.48–1992 (Permanence of Paper).

Registered Charity No. 207890.



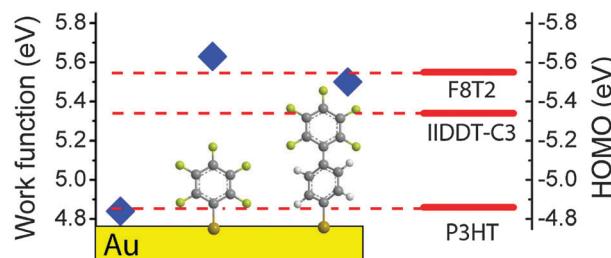
PAPERS

3007

Modulating the charge injection in organic field-effect transistors: fluorinated oligophenyl self-assembled monolayers for high work function electrodes

Oliver Fenwick, Colin Van Dyck, Kathiresan Murugavel, David Cornil, Federica Reinders, Sébastien Haar, Marcel Mayor,* Jérôme Cornil* and Paolo Samori*

Experiment and theory reveals origin of work function and contact resistance of fluorinated oligophenylthiol-treated electrodes in organic transistors.

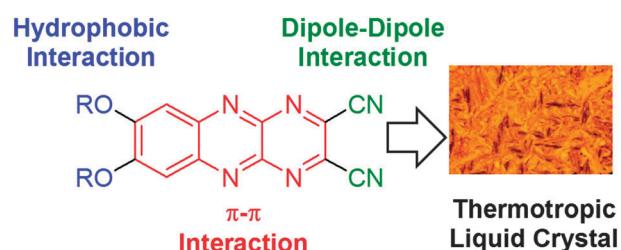


3016

Electron-deficient acene-based liquid crystals: dialkoxydicyanopyrazinoquinoxalines

Takashi Takeda,* Jun'ya Tsutsumi, Tatsuo Hasegawa, Shin-ichiro Noro, Takayoshi Nakamura and Tomoyuki Akutagawa*

Dialkoxydicyanopyrazinoquinoxaline exhibited liquid crystallinity, which was cooperatively stabilized by three noncovalent interactions, *i.e.* hydrophobic interaction, dipole–dipole interaction and π – π interaction.

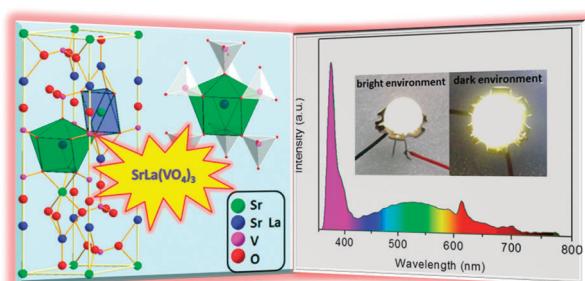


3023

Luminescence study of a self-activated and rare earth activated $\text{Sr}_3\text{La}(\text{VO}_4)_3$ phosphor potentially applicable in W-LEDs

Jiangcong Zhou, Feng Huang,* Ju Xu, Hui Chen and Yuansheng Wang*

A novel self-activated and rare earth activated $\text{Sr}_3\text{La}(\text{VO}_4)_3$ phosphor is potentially applicable in near UV excited W-LEDs.

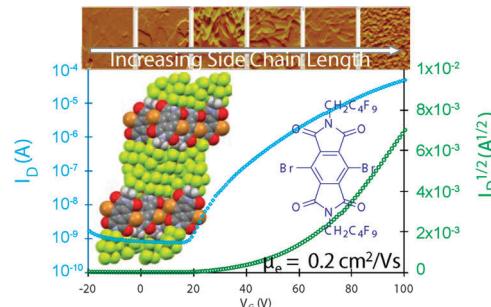


3029

Effect of side chain length on film structure and electron mobility of core-unsubstituted pyromellitic diimides and enhanced mobility of the dibrominated core using the optimized side chain

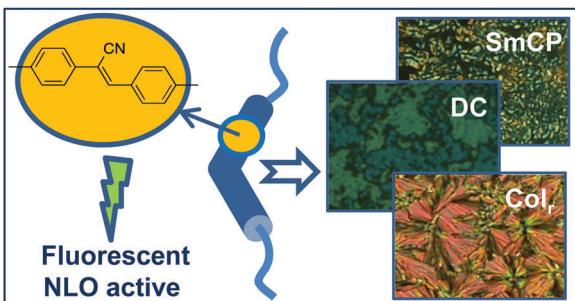
Ming-Ling Yeh, Szu-Ying Wang, Josué F. Martínez Hardigree, Vitaly Podzorov and Howard E. Katz*

Film structures and mobilities of pyromellitic diimides (PyDI) were investigated; perfluorobutylmethyl chain on 3,6-dibromo PyDI showed exceptional packing and mobility.



PAPERS

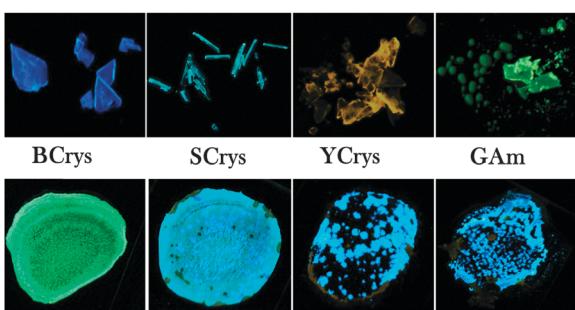
3038

**Cyanostilbene bent-core molecules: a route to functional materials**

M. Martínez-Abadía, B. Robles-Hernández, B. Villacampa, M. R. de la Fuente, R. Giménez* and M. B. Ros*

Multifunctional bent-core liquid crystals have been obtained by the incorporation of the high current interest cyanostilbene unit into a bent-shaped structure.

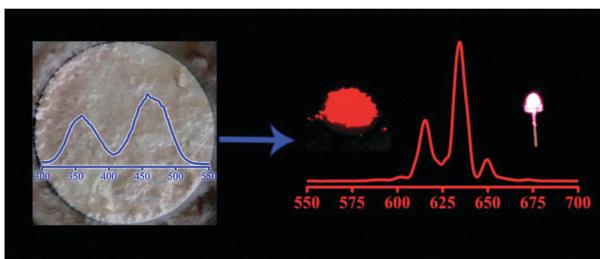
3049

**Polymorphic crystals and their luminescence switching of triphenylacrylonitrile derivatives upon solvent vapour, mechanical, and thermal stimuli**

Yujian Zhang, Qingbao Song, Kai Wang, Wengang Mao, Feng Cao, Jingwei Sun, Lingling Zhan, Yaokang Lv, Yuguang Ma, Bo Zou* and Cheng Zhang*

The organic crystals BCrys, SCrys and YCrys with the blue, sky-blue, and yellow fluorescence, respectively exhibit the responsive fluorescence switching under grinding, heating and solvent vapour stimulation.

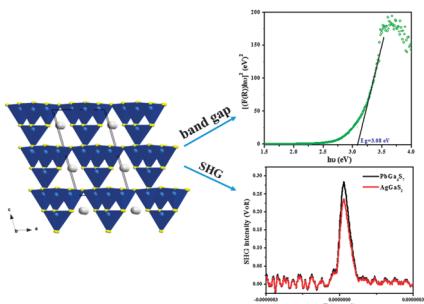
3055

**A new red phosphor $\text{BaGeF}_6:\text{Mn}^{4+}$: hydrothermal synthesis, photo-luminescence properties, and its application in warm white LED devices**

Qiang Zhou, Yayun Zhou, Yong Liu, Lijun Luo, Zhengliang Wang,* Jinhui Peng, Jing Yan and Mingmei Wu*

A new red phosphor $\text{BaGeF}_6:\text{Mn}^{4+}$ prepared by a hydrothermal route shows intense red emission under blue light excitation, which may find application in warm white LED devices.

3060

 **PbGa_4S_7 : a wide-gap nonlinear optical material**

Xiaoshuang Li, Lei Kang, Chao Li, Zheshuai Lin, Jiyong Yao* and Yicheng Wu

PbGa_4S_7 possesses a large powder second harmonic generation response and a large direct band gap of 3.08 eV.

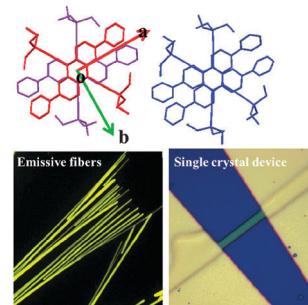
PAPERS

3068

A cross-dipole stacking molecule of an anthracene derivative: integrating optical and electrical properties

Jie Liu, Lingqiang Meng, Weigang Zhu, Congcong Zhang, Hantang Zhang, Yifan Yao, Zongrui Wang, Ping He, Xiaotao Zhang, Ying Wang, Yonggang Zhen, Huanli Dong, Yuanping Yi and Wenping Hu*

The present work showed the synthesis of a cross stacking molecule. And both semiconducting properties and solid state luminescence were achieved for its micro/nano fibers.

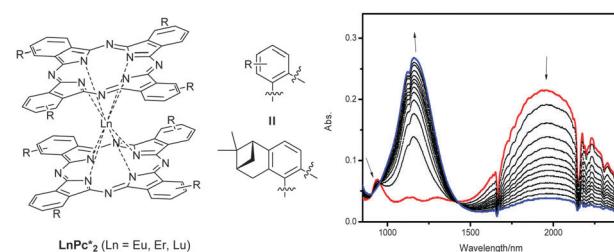


3072

Electrochromic properties of novel octa-pinene substituted double-decker Ln(III) ($\text{Ln} = \text{Eu, Er, Lu}$) phthalocyanines with distinctive near-IR absorption

Wei Zheng, Bei-Bei Wang, Jian-Cheng Lai, Cheng-Zhang Wan, Xin-Rong Lu, Cheng-Hui Li* and Xiao-Zeng You*

The introduction of pinene groups into lanthanide(III) double-decker phthalocyanines results in excellent solubility as well as nontrivial spectral and electrochemical properties. Upon external potential, the new lanthanide(III) double-decker phthalocyanine complexes show electrochromic properties at both visible and near infrared range.

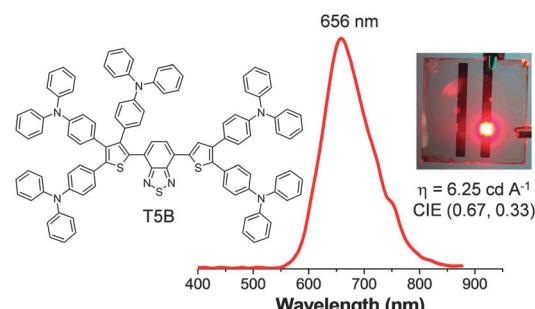


3081

Multi-triphenylamine-substituted bis(thiophenyl)-benzothiadiazoles as highly efficient solution-processed non-doped red light-emitters for OLEDs

A. Thangthong, N. Prachumrak, S. Saengsuwan, S. Namuangruk, T. Keawin, S. Jungsuttiwong, T. Sudyoadsuk and V. Promarak*

New bis(thiophenyl)benzothiadiazoles showed an outstanding potential as non-doped red emitter for OLEDs.

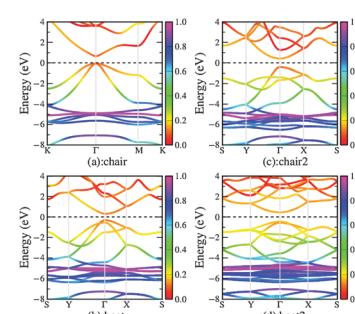


3087

The tunable electronic structure and mechanical properties of halogenated silicene: a first-principles study

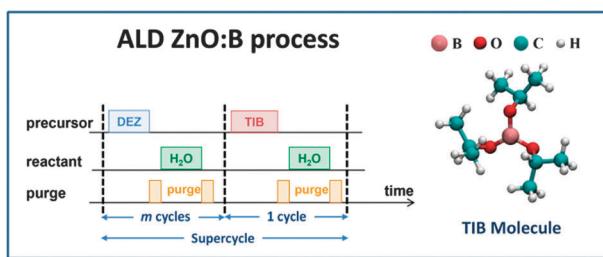
Wei-Bing Zhang,* Zhi-Bo Song and Liu-Ming Dou

Halogenated silicene, with enhanced stability compared with silicene, presents a moderate and tunable direct gap with small carrier effective mass and improved elastic properties.



PAPERS

3095

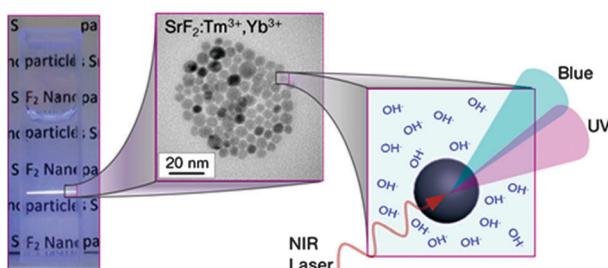


Atomic layer deposition of B-doped ZnO using triisopropyl borate as the boron precursor and comparison with Al-doped ZnO

Diana Garcia-Alonso, Stephen E. Potts, Cristian A. A. van Helvoirt, Marcel A. Verheijen and Wilhelmus M. M. Kessels*

The doping efficiency and hence the electrical properties of atomic layer deposited ZnO can be improved by using a novel, safer boron precursor.

3108

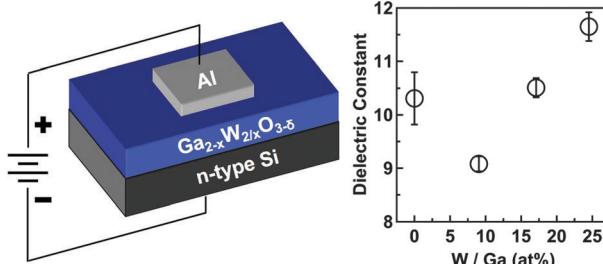


Intense ultraviolet upconversion in water dispersible SrF₂:Tm³⁺,Yb³⁺ nanoparticles: the effect of the environment on light emissions

M. Quintanilla, I. X. Cantarelli, M. Pedroni, A. Speghini* and F. Vetrone*

Ultrasmall and water dispersible SrF₂:Tm³⁺,Yb³⁺ upconverting nanoparticles show intense ultraviolet emissions after 980 nm excitation.

3114

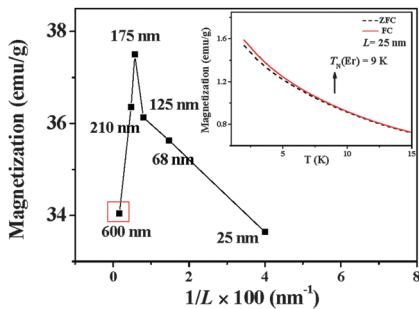


Aqueous-based synthesis of gallium tungsten oxide thin film dielectrics

Richard P. Oleksak, William F. Stickle and Gregory S. Herman*

Gallium tungsten oxide thin films formed from a single aqueous precursor. The highly controllable metal content allowed for fine-tuning of film dielectric and optical properties.

3121



A facile and environmentally friendly route to multiferroic nanorods and their size-dependent magnetic properties

Songping Wu,* Yichao Lv, Mingjia Lu and Zhiqun Lin*

Size-tunable uniform ErMn₂O₅ nanorods were synthesized via a surfactant-templated hydrothermal route. They exhibited strong size dependent magnetic properties, that is, a critical length of nanorods for magnetization due to the competition between uncompensated spin and surface strain.

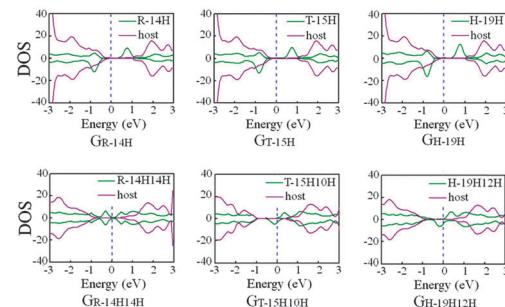
PAPERS

3128

Dehydrogenation: a simple route to modulate magnetism and spatial charge distribution of germanane

Yungang Zhou,* Kezhao Liu, Haiyan Xiao, Xia Xiang, Jinlan Nie, Sean Li,* He Huang and Xiaotao Zu*

Both magnetism and charge distribution of germanane can be effectively modulated via a simple dehydrogenating process.

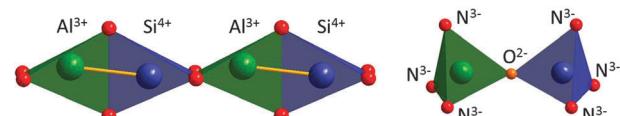


3135

Cation and anion ordering in $\text{Sr}_2\text{Si}_7\text{Al}_3\text{ON}_{13}$ phosphors

Graham King,* Kunio Ishida,* Katharine Page, Yumi Fukuda, Ariane Keiko Albessard, Yasushi Hattori, Ryosuke Hiramatsu, Iwao Mitsuishi, Aoi Okada, Masahiro Kato and Noburu Fukushima

A series of photoluminescent Ce^{3+} doped samples with compositions close to $\text{Sr}_2\text{Si}_7\text{Al}_3\text{ON}_{13}:\text{Ce}$ have been studied by neutron powder diffraction to determine the $\text{Si}^{4+}/\text{Al}^{3+}$ and $\text{N}^{3-}/\text{O}^{2-}$ site ordering.

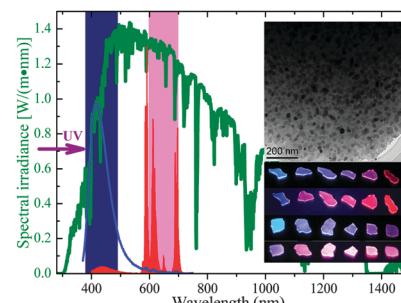


3141

Tuning into blue and red: europium single-doped nano-glass-ceramics for potential application in photosynthesis

Daqin Chen,* Zhongyi Wan, Yan Zhou, Weidong Xiang,* Jiasong Zhong, Mingye Ding, Hua Yu and Zhenguo Ji*

Nano-glass-ceramics, which can convert ultraviolet photons into blue/red ones, were explored for potential application in the photosynthesis of plants.

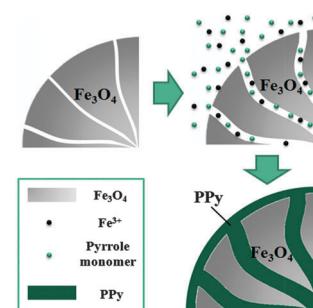


3150

Magnetite–polypyrrole core–shell structured microspheres and their dual stimuli-response under electric and magnetic fields

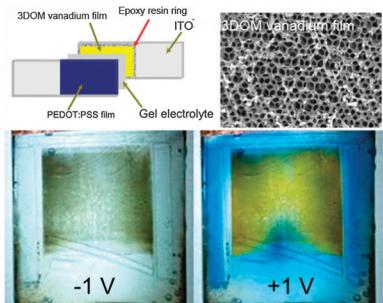
Dae Eun Park, Hyun Sik Chae, Hyoung Jin Choi* and Arjun Maity

Polypyrrole (PPy)-coated magnetite (Fe_3O_4) hybrid particles were synthesized under sonication.



PAPERS

3159

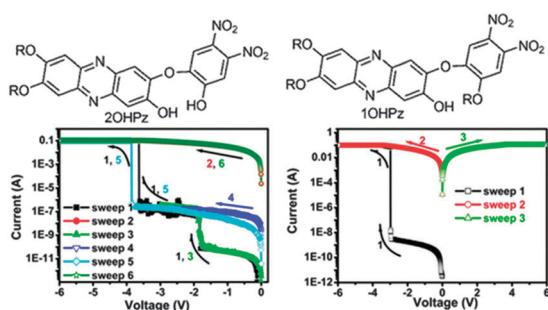


Versatile displays based on a 3-dimensionally ordered macroporous vanadium oxide film for advanced electrochromic devices

Zhongqiu Tong, Haowei Yang, Li Na, Huiying Qu, Xiang Zhang, Jiupeng Zhao* and Yao Li*

An electrochromic device based on a 3DOM vanadium oxide film and a PEDOT:PSS film was fabricated, and this device shows multicolor changes with fast switching speed and good cycling stability.

3167

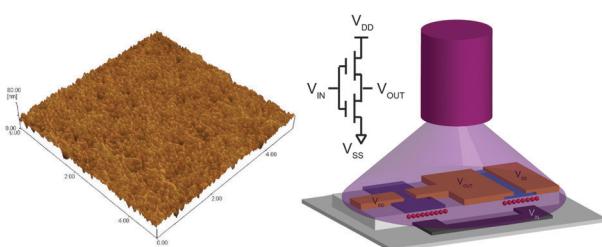


The substituent group effect on the morphology and memory performance of phenazine derivatives

Pei-Yang Gu, Yong Ma, Jing-Hui He, Guankui Long, Chengyuan Wang, Wangqiao Chen, Yi Liu, Qing-Feng Xu,* Jian-Mei Lu* and Qichun Zhang*

The memory devices based on ITO/2OHPz/Al exhibited excellent ternary memory behavior while devices based on ITO/1OHPz/Al displayed binary memory behavior.

3173

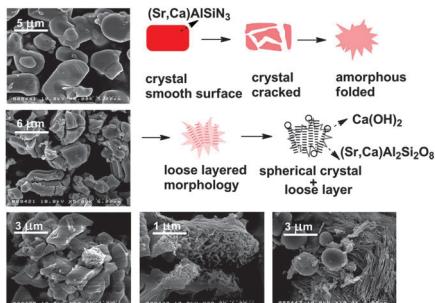


CdSe/ZnS core–shell quantum dots charge trapping layer for flexible photonic memory

Su-Ting Han, Ye Zhou, Li Zhou, Yan Yan, Long-Biao Huang, Wei Wu and V. A. L. Roy*

A novel design of UV-manipulated photonic nonvolatile memory based on spin-coated close-packed CdSe/ZnS quantum dots is reported.

3181



Moisture-induced degradation and its mechanism of (Sr,Ca)AlSiN₃:Eu²⁺, a red-color-converter for solid state lighting

Jie Zhu, Le Wang,* Tianliang Zhou, Yujin Cho, Takayuki Suehiro, Takashi Takeda, Ming Lu, Takashi Sekiguchi, Naoto Hirosaki and Rong-Jun Xie*

The degradation of (Sr,Ca)AlSiN₃:Eu²⁺ induced by the water steam attack results in remarkable changes in luminescence, microstructure and phase purity.

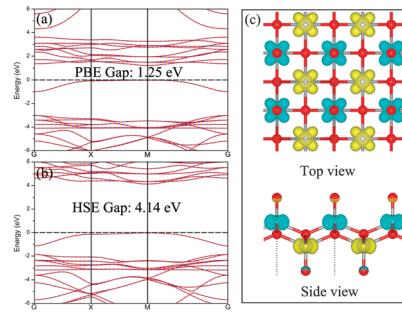
PAPERS

3189

Two-dimensional square-pyramidal VO₂ with tunable electronic properties

Zhen-Kun Tang, Xi-Bo Li, Deng-Yu Zhang,
Yan-Ning Zhang and Li-Min Liu*

In order to design the high-performance spintronics, it is rather critical to develop new materials, which can easily regulate the magnetism of nanostructures.

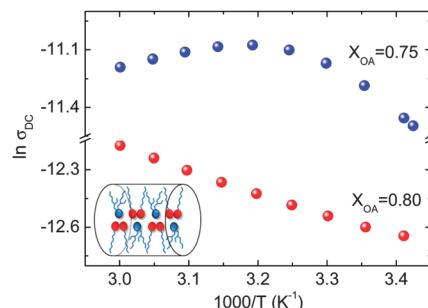


3198

Anti-Arrhenian behaviour of conductivity in octanoic acid–bis(2-ethylhexyl)amine systems: a physico-chemical study

Pietro Calandra,* Vincenzo Turco Liveri,
Angela Monia Ruggirello, Mariano Licciardi,
Domenico Lombardo and Andrea Mandanici

A transition from Arrhenian to anti-Arrhenian behavior of DC conductivity has been found in octanoic acid–bis(2-ethylhexyl)amine liquid mixtures.

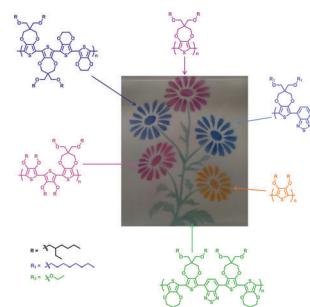


3211

Tuning the painter's palette: subtle steric effects on spectra and colour in conjugated electrochromic polymers

J. A. Kerszulis, K. E. Johnson, M. Kuepfert, D. Khoshabo,
A. L. Dyer and J. R. Reynolds*

A series of vibrantly coloured π -conjugated electrochromic polymers (ECPs) were designed and synthesized with the goal of extracting structure–property relationships from subtle changes in steric strain or relaxation.



3219

Tri-wavelength broadband antireflective coating built from refractive index controlled MgF₂ films

Ruimin Ding, Xinmin Cui, Cong Zhang, Ce Zhang and
Yao Xu*

Tri-wavelength broadband AR coating derived from refractive index controlled MgF₂ films was realized through controlling the self-assembly process of MgF₂ nanocrystals.

