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A journal at the forefront of the design and understanding of solid-state and crystalline materials  
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## IN THIS ISSUE

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### Inside cover

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## COLLECTION: CRYSTAL ENGINEERING WITH IONIC LIQUIDS

## EDITORIAL

4873

### Crystal engineering with ionic liquids

Mark J. Muldoon, Peter Nockemann and M. Cristina Lagunas

Welcome to this *CrystEngComm* collection on crystal engineering in ionic liquids.



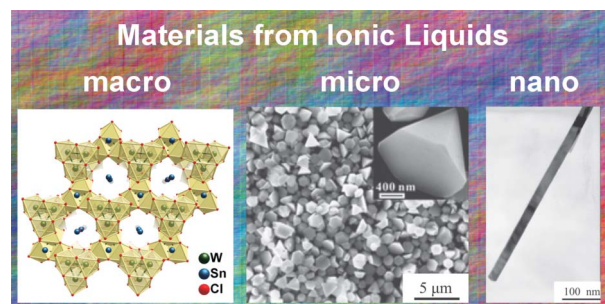
## HIGHLIGHT

4874

### Ionic liquids as crystallisation media for inorganic materials

Ejaz Ahmed, Joachim Breternitz, Matthias Friedrich Groh and Michael Ruck\*

Ionic liquids are playing an important role as crystallisation media in materials science. Some recent developments to crystallise inorganic materials are highlighted.



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of crystal engineering including properties, polymorphism, crystal growth, target materials and new or  
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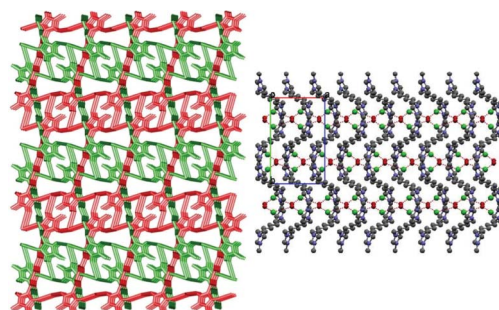
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4886

### Supramolecular architectures of symmetrical dicationic ionic liquid based systems

Haregewine Tadesse, Alexander J. Blake, Neil R. Champness, John E. Warren, Pierre J. Rizkallah and Peter Licence\*

We report the crystal structures of dicationic ionic liquids with both modified cation and anion moieties and discuss the influence of the “*supramolecular ionic liquid architecture*” that these subtle changes incur.

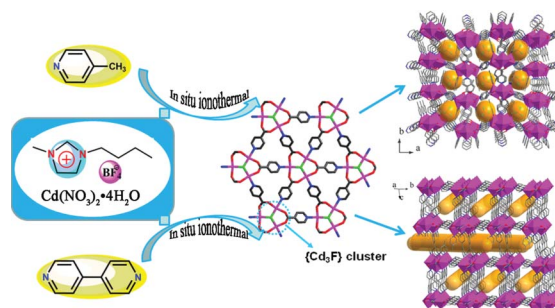


4894

### The multifunctional roles of the ionic liquid [Bmim][BF<sub>4</sub>] in the creation of cadmium metal–organic frameworks

Zai-Lai Xie, Mei-Ling Feng, Bin Tan and Xiao-Ying Huang\*

An “all-in-one” ionothermal synthesis of {Cd<sub>3</sub>F} metal–organic frameworks is presented, where [Bmim][BF<sub>4</sub>] acts as a solvent, structure-directing agent, ligand precursor and promoter.

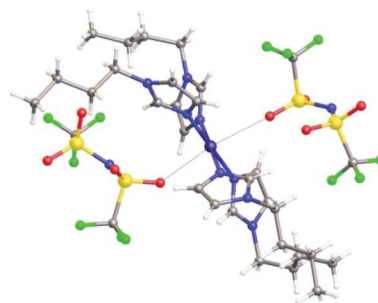


4902

### Crystal structures of low-melting ionic transition-metal complexes with *N*-alkylimidazole ligands

Tom Vander Hoogerstraete, Neil R. Brooks, Bernadette Norberg, Johan Wouters, Kristof Van Hecke, Luc Van Meervelt and Koen Binnemans\*

The crystal structures of a series of ionic liquids with copper(II), nickel(II) or cobalt(II)-containing cations and *N*-alkylimidazole ligands are described.

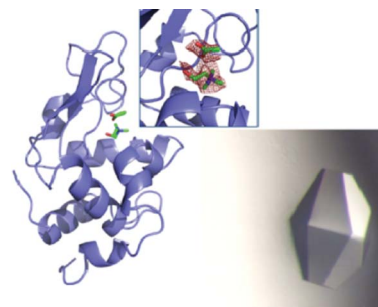


4912

### Hofmeister effects of ionic liquids in protein crystallization: Direct and water-mediated interactions

Magdalena Kowacz,\* Abhik Mukhopadhyay, Ana Luísa Carvalho, José M. S. S. Esperança, Maria J. Romão and Luís Paulo N. Rebelo\*

Lysozyme crystal grown from a neat ionic liquid (IL) solution with the IL cation and anion incorporated in the structure.





# New process for crystal data files

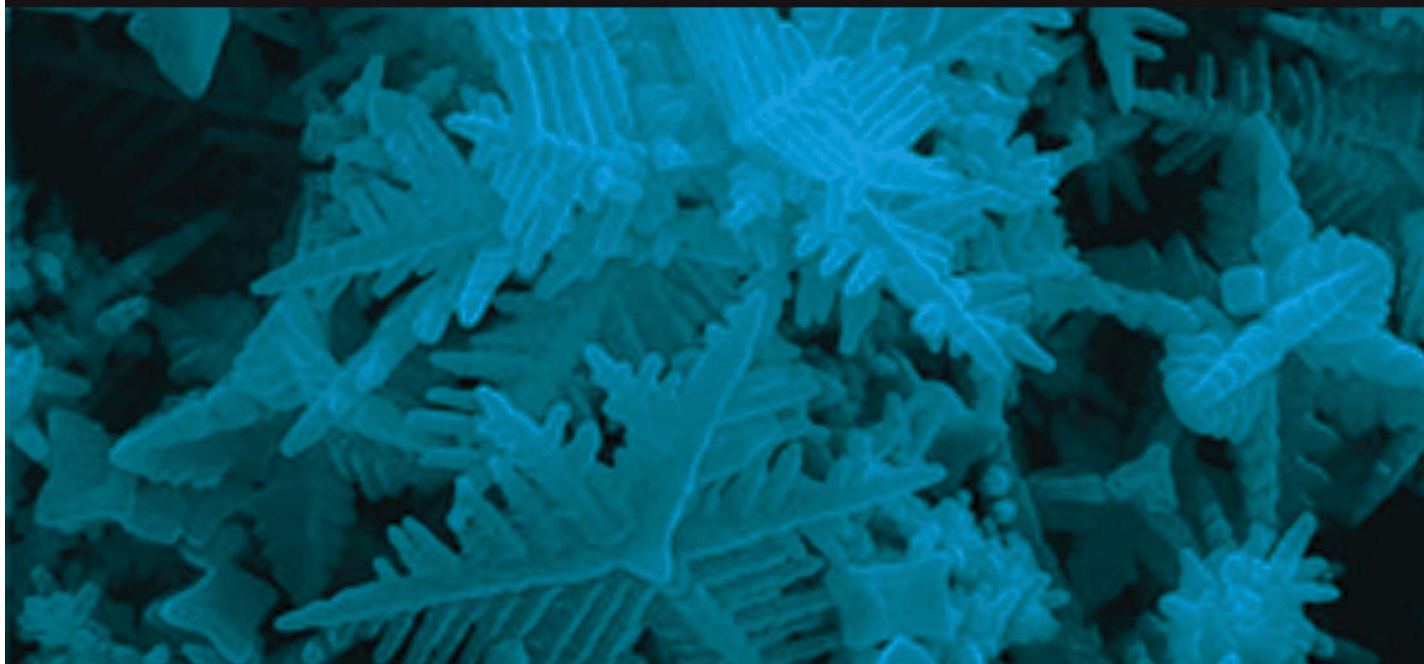


Image courtesy of Professor Gang Chen and Dr Rencheng Jin DOI: 10.1039/C2CE06417K

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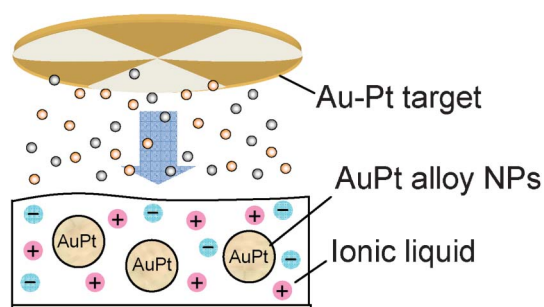
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4922

### Compositional control of AuPt nanoparticles synthesized in ionic liquids by the sputter deposition technique

Shushi Suzuki,\* Toshimasa Suzuki, Yousuke Tomita, Masanori Hirano, Ken-ichi Okazaki, Susumu Kuwabata and Tsukasa Torimoto\*

Bimetallic alloy nanoparticles (NPs) are attractive materials for exploring advanced functions to reduce consumption of resources and energy.

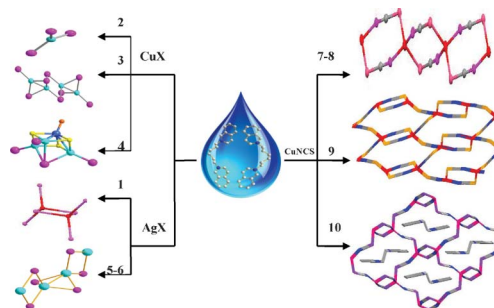


4927

### The anion exchange reaction of bis(isoquinoline) ionic liquids: self-assembly, crystal structures and thermal properties of ten novel $d^{10}$ metal (Cu, Ag) halide/thiocyanate supramolecular polymers

Li-Sha Song, Hong-Mei Wang, Yun-Yin Niu,\* Hong-Wei Hou and Yu Zhu

Six  $1,\omega$ -bis(isoquinoline) ionic liquids were synthesized and utilized to construct ten novel 0, 1 and 2D cluster-based supramolecular polymeric frameworks by anion exchange and self-assembly.

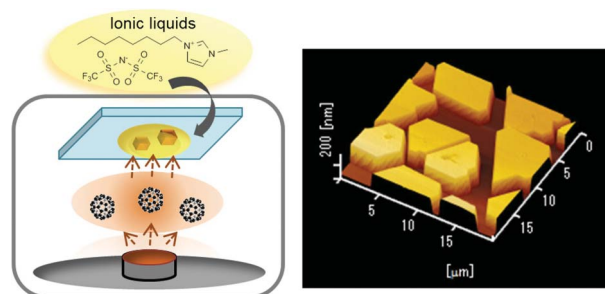


4939

### Ionic liquid-mediated epitaxy of high-quality $C_{60}$ crystallites in a vacuum

Yoko Takeyama, Shingo Maruyama, Hiroki Taniguchi, Mitsuru Itoh, Keiji Ueno and Yuji Matsumoto\*

The ionic liquid-mediated epitaxy of hexagonal-shaped large  $C_{60}$  crystallites with molecularly smooth surfaces on  $MoS_2$  are reported.

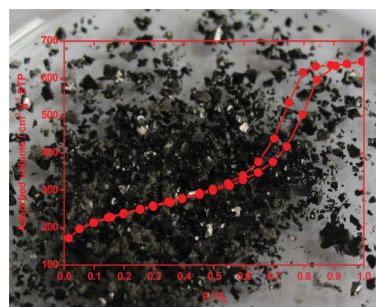


4946

### Synthesis of mesoporous carbon/iron carbide hybrids with unusually high surface areas from the ionic liquid precursor [Bmim][FeCl<sub>4</sub>]

Ronald Göbel, Zai-Lai Xie, Mike Neumann, Christina Günter, Ruben Löbbicke, Shiori Kubo, Maria-Magdalena Titirici, Cristina Giordano\* and Andreas Taubert\*

Mesoporous carbon/iron carbide hybrid materials were synthesized *via* an exotemplating route using monolithic mesoporous silica as template and the ionic liquid [Bmim][FeCl<sub>4</sub>] as carbon and iron source.



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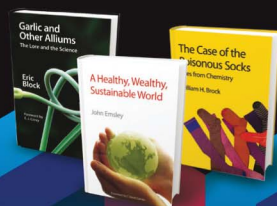
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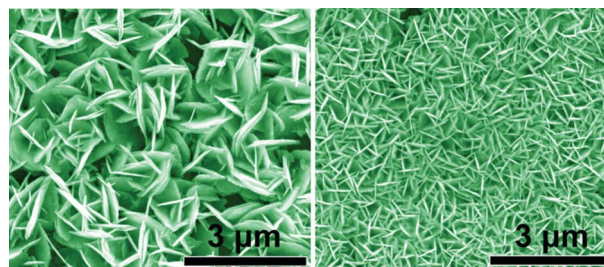


4952

### Fast fabrication of homogeneous silver nanostructures on hydrazine treated polyaniline films for SERS applications

Jiaojiao He, Xijiang Han,\* Jun Yan, Leilei Kang, Bin Zhang, Yunchen Du, Cunku Dong, Hsing-Lin Wang and Ping Xu\*

Homogeneous silver nanostructures are fabricated on hydrazine treated polyaniline films within one minute, which show high SERS responses.

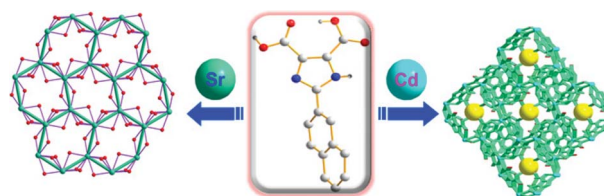


4955

### Two unprecedented strontium(II) and cadmium(II) MOFs constructed from 2-naphthyl imidazole dicarboxylate ligand

Mengwei Guo, Nan Chen, Zhifang Yue, Yu Zhang and Gang Li\*

Two new coordination polymers,  $[\text{Sr}(\mu_5\text{-HNIDC})(\text{H}_2\text{O})]_n$  (1),  $[\text{Cd}(\mu_3\text{-HNIDC})(\text{CH}_3\text{CH}_2\text{OH})]_n$  (2), ( $\text{H}_3\text{NIDC}$  = 2-(2-naphthyl)-1*H*-imidazole-4,5-dicarboxylic acid) have been hydrothermally synthesized and characterized.

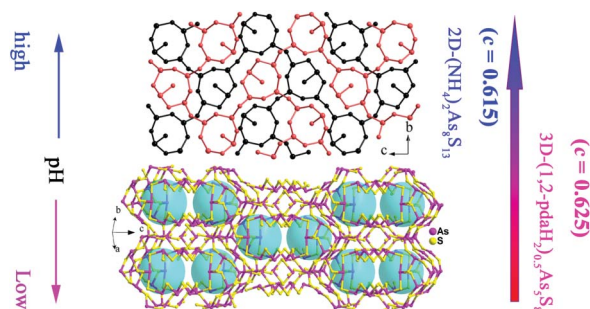


4959

### pH-induced solvothermal synthesis and characterization of two novel thioarsenate compounds: Three-dimensional $(1,2\text{-pdaH}_2)_{0.5}\text{As}_5\text{S}_8$ containing $\psi\text{-As(III)S}_4$ and two-dimensional $(\text{NH}_4)_2\text{As}_8\text{S}_{13}$

Ke-Zhao Du, Mei-Ling Feng, Jian-Rong Li and Xiao-Ying Huang\*

Two chalcogenidoarsenates, namely  $(1,2\text{-pdaH}_2)_{0.5}\text{As}_5\text{S}_8$  representing the first three-dimensional chalcogenidoarsenate and a lamellar network  $(\text{NH}_4)_2\text{As}_8\text{S}_{13}$ , are obtained through pH-induced solvothermal synthesis.

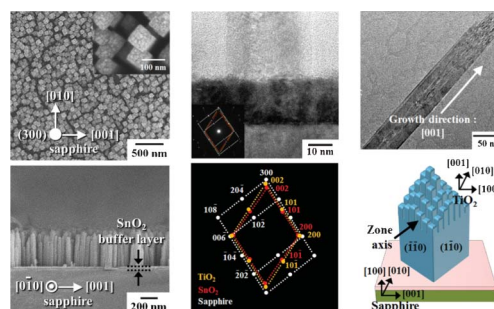


4963

### Hetero-epitaxial growth of vertically-aligned $\text{TiO}_2$ nanorods on an *m*-cut sapphire substrate with an (001) $\text{SnO}_2$ buffer layer

Won-Sik Kim, Yun-Guk Jang, Dai-Hong Kim, Hong-Chan Kim and Seong-Hyeon Hong\*

Vertically aligned  $\text{TiO}_2$  nanorods were epitaxially grown on  $\text{SnO}_2$  buffered *m*-cut sapphire and the epitaxial relationships and growth characteristics were investigated.



“ When you are face to face with a difficulty, you are up against a discovery ■

**Lord Kelvin (William Thomson)**

Born in Belfast, Northern Ireland, 26 June 1824 – 17 December 1907

*Scottish mathematical physicist and engineer – significant contributions to science including the second law of thermodynamics and set up the absolute temperature scale (measured in kelvins)*

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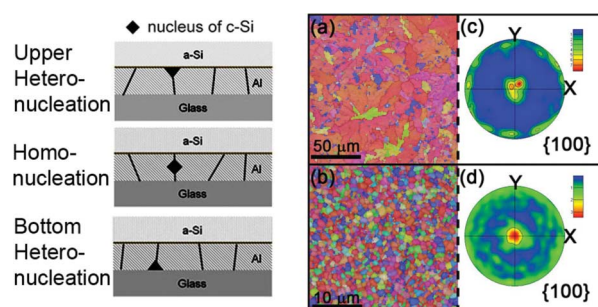
## COMMUNICATIONS

4967

**Ultrafast Al(Si)-induced crystallisation process at low temperature**

Sung-Yen Wei, Sheng-Min Yu, Li-Chi Yu, Wen-Ching Sun, Chien-Kuo Hsieh, Tzer-Shen Lin, Chuen-Horng Tsai and Fu-Rong Chen\*

Aluminium-induced crystallisation was accelerated by a factor of about 50 by the doping of Si atoms into the initial Al.

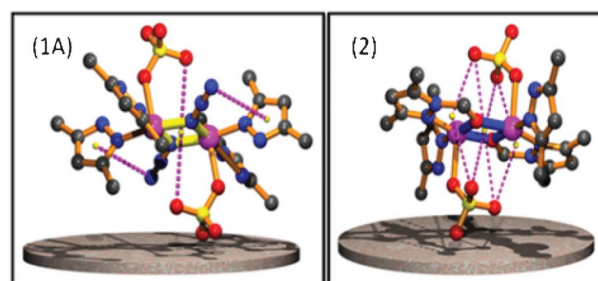


4972

 **$\sigma$ -Aromaticity in dinuclear copper(II) complexes: Novel interaction between perchlorate anion and  $\sigma$ -aromatic  $[\text{Cu}_2\text{X}_2]$  ( $\text{X} = \text{N}$  or  $\text{O}$ ) core**

Ishita Banerjee, Malay Dolai, Atish Dipankar Jana, Kalyan K. Das and Mahammad Ali\*

The complexes **1** and **2** with  $[\text{Cu}_2\text{X}_2]$  rhombus cores exhibit  $\sigma$ -aromaticity that unprecedentedly interact with coordinated perchlorate ions.

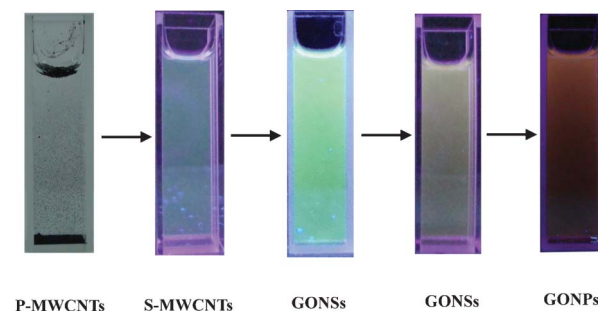


4976

**Multicolour fluorescent graphene oxide by cutting carbon nanotubes upon oxidation**

Zhaosheng Qian,\* Chen Wang, Gaohui Du, Jin Zhou, Congcong Chen, Juanjuan Ma, Jianrong Chen and Hui Feng\*

Graphene oxide nanoparticles with colourful photoluminescence were prepared by continuous chemical oxidation with multi-walled carbon nanotubes as precursor, and the fluorescence colours can be tuned by the level of oxidation.



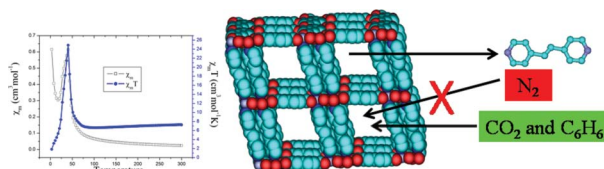
## PAPERS

4980

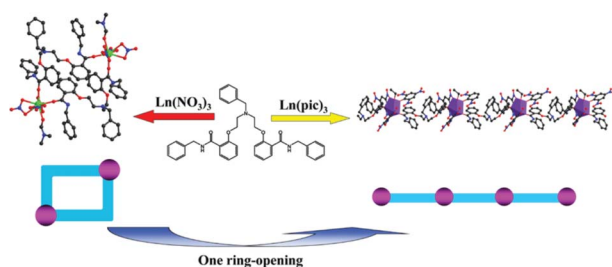
 **$\{[\text{Co}_2(\text{ndc})_2(\text{bpee})_2](\text{bpee})\}$ : a 3D multifunctional MOF**

Rajat Saha and Sanjay Kumar\*

A multifunctional 2-fold interpenetrated 3D MOF exhibits selective adsorption, canted antiferromagnetism and magnetic enhancement after removal of guest molecules.



4989

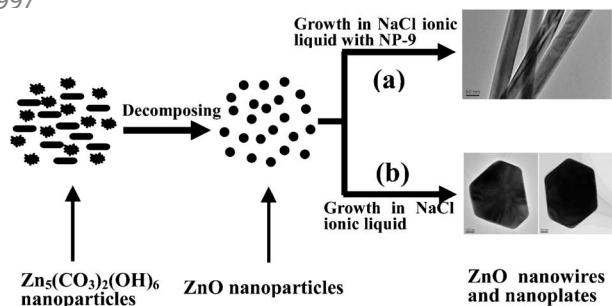


### Anions make the difference: conversion from zero- to one-dimensional structures and luminescent properties of lanthanide-based complexes

Xuhuan Yan, Zhenzhong Yan, Ye Zhang, Weisheng Liu, Yu Tang\* and Minyu Tan

Zero-dimensional dinuclear macrocycle architectures and one-dimensional chain patterns were self-assembled by an amide type ligand with lanthanide nitrates and picrates. The structure variations are mainly attributed to the anions effect.

4997

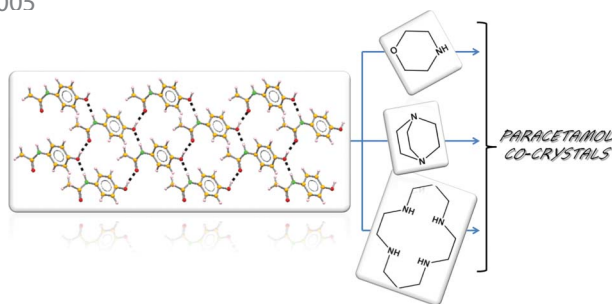


### Morphology-controlled synthesis and growth mechanism of ZnO nanostructures *via* the NaCl nonaqueous ionic liquid route

Wenzhong Wang,\* Lijuan Wang, Lei Liu, Chen He, Jian Tan and Yujie Liang

ZnO nanowires and nanoplates were synthesized by a facile and environmentally friendly NaCl nonaqueous ionic liquid route.

5005

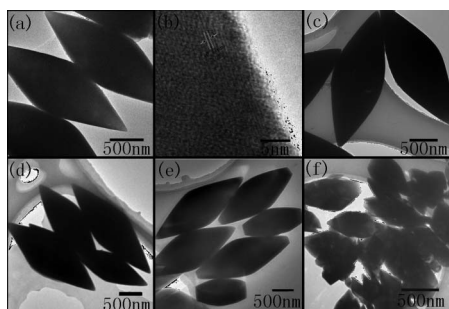


### Revisiting paracetamol in a quest for new co-crystals

Vânia André, M. Fátima M. da Piedade and M. Teresa Duarte\*

Paracetamol, one of the most widely available analgesic, is long known, but still a challenge for crystal engineers.

5015



### Controlled synthesis and luminescence properties of rhombic NaLn(MoO<sub>4</sub>)<sub>2</sub> submicrocrystals

Ying Li, Guofeng Wang,\* Kai Pan, Wei Zhou, Cheng Wang, Naiying Fan, Yajie Chen, Qingmao Feng and Binbin Zhao

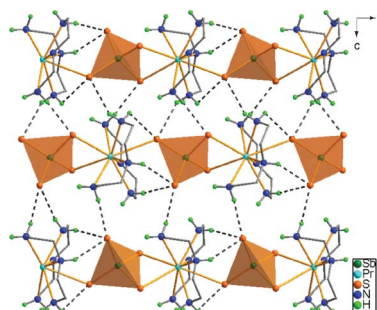
Tetragonal phase NaLn(MoO<sub>4</sub>)<sub>2</sub> submicrocrystals were successfully synthesized by a hydrothermal method.

5021

### Solvothermal syntheses and characterizations of lanthanide(III)/ $\text{SbS}_4^{3-}$ complexes associated by a dien ligand: A detailed study based on the lanthanide contraction effect

Weiwei Tang, Ruihong Chen, Jing Zhao, Wenqing Jiang, Yong Zhang and Dingxian Jia\*

Two structural types of lanthanide(III)/ $\text{SbS}_4^{3-}$  complexes are formed in the Ln/Sb/S/dien system. The structure change is affected by the ion size and coordination number requirements of  $\text{Ln}^{3+}$  ions.

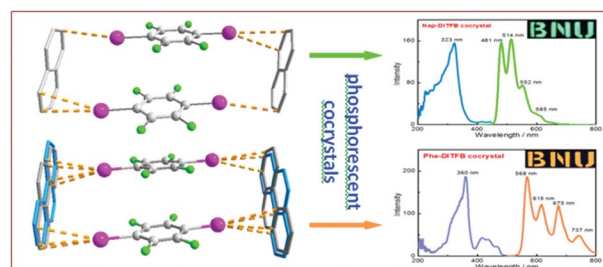


5027

### Phosphorescent cocrystals constructed by 1,4-diiodotetrafluorobenzene and polyaromatic hydrocarbons based on $\text{C-I}\cdots\pi$ halogen bonding and other assisting weak interactions

Qian Jin Shen, Xue Pang, Xiao Ran Zhao, Hai Yue Gao, Hao-Ling Sun\* and Wei Jun Jin\*

Phosphorescent cocrystals are assembled based on  $\text{C-I}\cdots\pi$  halogen bonding and the luminescence wavelength of phenanthrene is largely modulated in the cocrystal.

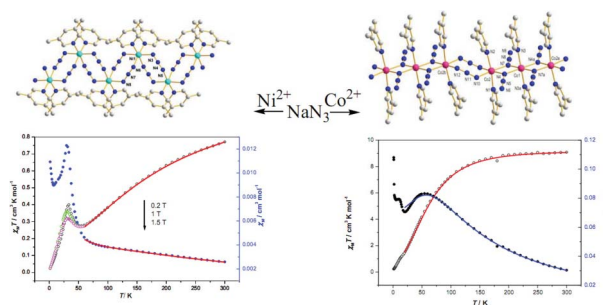


5035

### Spin canting and metamagnetism in the two azido-bridged 1D complexes $[\text{Ni}(\text{3,5-dmpy})_2(\text{N}_3)_2]_n$ and $[\text{Co}_{1.5}(\text{3,5-dmpy})_3(\text{N}_3)_3]_n$

Zhengliang Lu,\* Patrick Gamez, Hui-Zhong Kou, Chunhua Fan,\* Haitao Zhang and Guoxin Sun

Two 1D systems have been synthesized and magnetically characterized. The magnetic studies reveal complex **1** and **2** exhibit spin canting antiferromagnetic interactions through the azido-bridged chain.

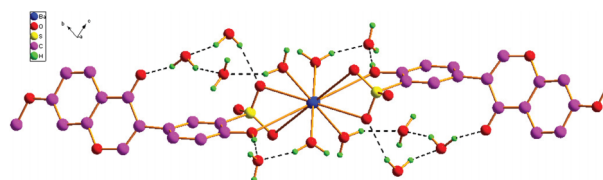


5042

### Four 3D metal–organic frameworks derived from barium(II) and isoflavonesulfonate ligands

Zun-Ting Zhang,\* Qiu-Ya Wang, Wu-Wu Li, Qing-Hua Meng and Xue-Ling Zhang

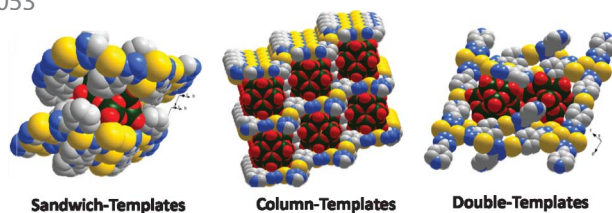
Four 3D metal–organic frameworks based on barium(II) and isoflavonesulfonate ligands were obtained and the influences of different substituents in the isoflavonesulfonate ligands on the self-assembly manners were investigated.





## PAPERS

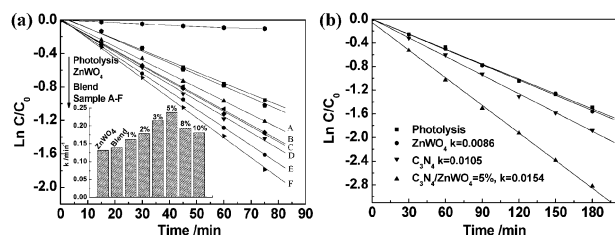
5053

**Syntheses of POM-templated MOFs containing the isomeric pyridyltetrazole**

Jing-Quan Sha, Jing-Wen Sun, Cheng Wang, Guang-Ming Li, Peng-Fei Yan,\* Meng-Ting Li and Ming-Yuan Liu

Due to the isomers of the pytz, the compounds display versatile POM-templated features, namely, sandwich-, column- and double-templates.

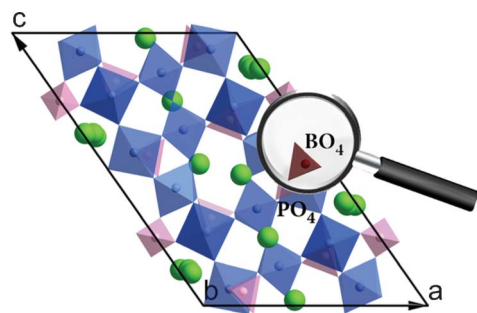
5065

**Graphite-like C<sub>3</sub>N<sub>4</sub> hybridized ZnWO<sub>4</sub> nanorods: Synthesis and its enhanced photocatalysis in visible light**

Yajun Wang, Zhenxing Wang, Safdar Muhammad and Jun He\*

Graphite-like C<sub>3</sub>N<sub>4</sub> hybridized ZnWO<sub>4</sub> photocatalyst is synthesized *via* a facile chemisorption.

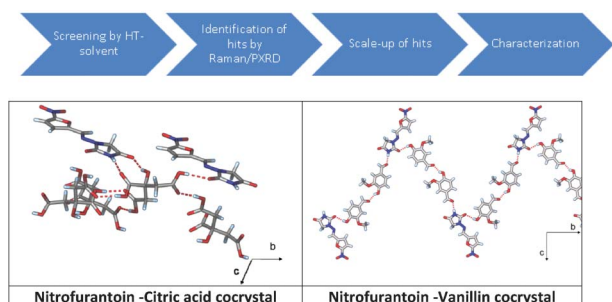
5071

**Structure-driven mixed-site borate–phosphate K<sub>5</sub>Ta<sub>8</sub>BP<sub>4</sub>O<sub>34</sub>: synthesis, structural, spectroscopic and theoretical study**

Artem A. Babaryk,\* Ievgen V. Odynets, Nikolay S. Slobodyanik, Vyacheslav N. Baumer and Sergei Khainakov

Tungstate bronze (TB) related borate–phosphate K<sub>5</sub>Ta<sub>8</sub>BP<sub>4</sub>O<sub>34</sub> is afforded from boron-enriched potassium–molybdate flux.

5078

**Pharmaceutical cocrystals of nitrofurantoin: screening, characterization and crystal structure analysis**

Amjad Alhalaweh, Sumod George, Srinivas Basavoju, Scott L. Childs, Syed A. A. Rizvi and Sitaram P. Velaga\*

The objective of this study was to screen and prepare cocrystals of the poorly soluble drug nitrofurantoin (NTF) with the aim of increasing its solubility.