NANOTECHNOLOGY

Nanotechnology™, the **first journal** dedicated to nanoscale research, presents some of the very best content published in 2015–2016

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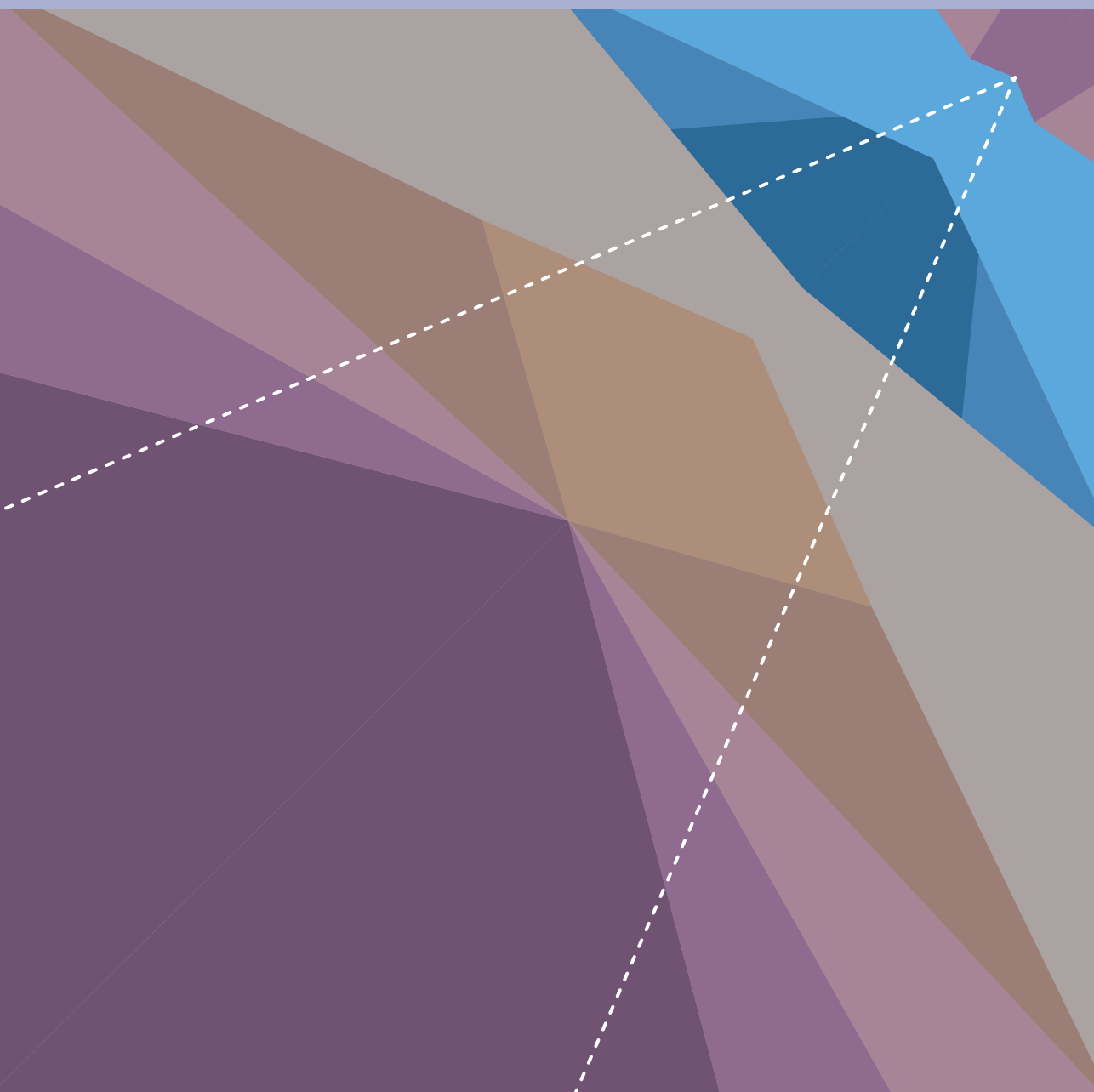

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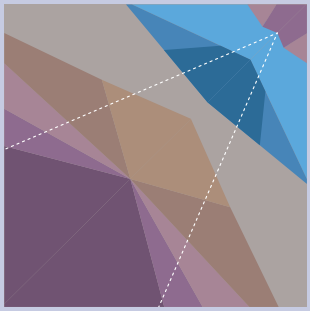


Front cover image:
Artistic interpretation showing a logic operation type as a function of pulse amplitudes for the output memcapacitive system **Y V Pershin *et al*** 2015 *Nanotechnology* **26** 225201

Foreword

Dear colleagues,

As the first peer-reviewed journal in nanoscale science and technology, *Nanotechnology*™ has seen the field develop from a select community early in its inception to the huge international research enterprise it is today. While the journal continues to house leading research papers and topical reviews that both define and influence the direction of activity in the field, we have introduced a number of innovations to ensure we meet the evolving needs of our community.

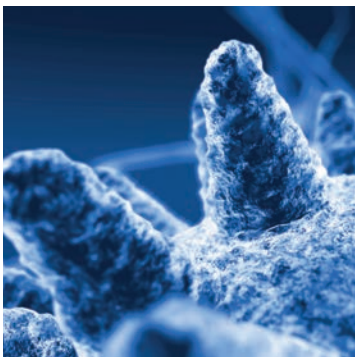
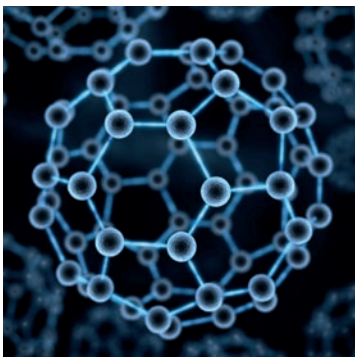
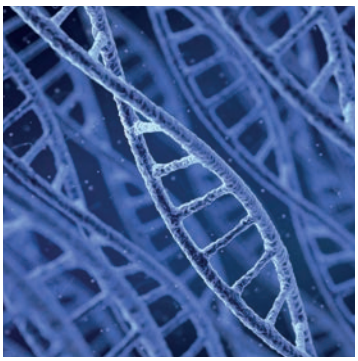
As of 2015, we are pleased to announce the publication of Letters in place of Fast Track Communications for rapid publication of high-impact developments without compromising on the rigour of peer review. We have also introduced focus collections that collect invited and unsolicited papers on leading results and developments in topical areas of research. By publishing papers in the collections as soon as they complete the stages required in peer review and production, we have eliminated the delays incurred by special issue publications.

The journal now publishes both viewpoint and industry-invited perspectives by leading researchers that focus either on a recent development published in the journal to provide context, or a topic as it moves from the lab to industry. As well as newsy LabTalk articles written by researchers to highlight their work in the journal, we have also introduced *Nanotechnology* Select, where every couple of weeks chosen papers are collated and featured on the homepage. The articles are also highlighted in a news article on **nanotechweb.org** by one of our journalists.

The journal has embraced the multimedia opportunities open to electronic publications with video abstracts, movie file supplementary data and now our first discussion webinar on nanophotonics in celebration of the International Year of Light. We hope that you enjoy this collection of highlights from 2015 and we look forward to many more to come at **iopscience.org/nano**.

Mark Reed
Editor-in-Chief, *Nanotechnology*
nano@iop.org
iopscience.org/nano

Contents

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Nanotechnology Young Researcher Award 2015

In 2015, *Nanotechnology* invited nominations for the Young Researcher Award. This is a new award that recognizes early career brilliance and is open to PhD students and researchers within the first five years of completing their PhD.

Jae Hyun Lee
Harvard University

We received more than 250 nominations for this award and the standard of entries was extremely high. We are pleased to announce that the winner of the 2015 Young Researcher Award is **Jae Hyun Lee**, currently working at Harvard University, selected by the *Nanotechnology* Editorial Board. The Editorial Board were particularly impressed with Lee's contributions across the areas of nanoMRI, theranostic nanoparticles and nanoswitches.

Also highly commended are the runners up for the prize, which include:

- **Sukang Bae**, Korea Institute of Science and Technology (KIST)
- **Scott Kevin Cushing**, West Virginia University
- **Renren Deng**, National University of Singapore
- **Jarvist Moore Frost**, University of Bath
- **Mengdi Han**, Peking University
- **Alireza Kargar**, University of California, San Diego
- **Weiyang Li**, Dartmouth College
- **Datao Tu**, Chinese Academy of Sciences
- **Chuan Wang**, Michigan State University

To read a full interview with the winner of the Young Researcher Award, visit **nanotechweb.org**.

This award recognizes the very best young researchers in the field of nanotechnology today, and there was an incredibly diverse and talented pool of nominees for the award.

Karl Berggren, MIT, *Nanotechnology* Editorial Board member.

Journal scope

3.821*

Impact Factor

*As listed in 2014 Journal Citation reports (Thomson Reuters 2015)®

1.4 million

***Nanotechnology* article downloads in 2015**

Nanotechnology publishes papers at the forefront of nanoscale science and technology, and especially those of an interdisciplinary nature. Here, nanotechnology is taken to include the ability to individually address, control, and modify structures, materials and devices with nanometre precision, and the synthesis of such structures into systems of micro- and macroscopic dimensions such as MEMS-based devices. It encompasses the understanding of the fundamental physics, chemistry, biology and technology of nanometre-scale objects and how such objects can be used in the areas of computation, sensors, nanostructured materials and nano-biotechnology.

To be publishable in this journal, papers must meet the highest scientific quality standards, contain significant and original new science, and should make substantial advances within a particular area of nanoscale science and technology. *Nanotechnology* publishes a range of article types including:

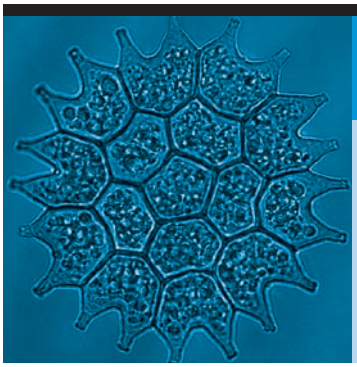
Research papers
Reports of original work, categorised by seven different journal sections, described overleaf.

Perspectives
Commentaries aimed at highlighting the significance, impact and wider implications of research appearing in *Nanotechnology*.

Focus Collections
A diverse selection of exclusive, articles, each serving to highlight work conducted in areas of particular current interest, as identified by the Editorial Board.

Letters
The journal offers open access and accelerated publication to outstanding short papers reporting new and timely developments in nanotechnology.

Topical Reviews
Review articles commissioned by the Editorial Board, which provide a snapshot of recent progress in a particular field.



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Visit **nanotechweb.org** for the latest news, products, jobs and events in all areas of nanotechnology.

Register online and you can receive our weekly news alert, with the latest information wrapped up in one useful e-mail.

Papers published in 2015

Nanotechnology research papers are separated into seven separate journal sections, reflecting the scope and content of the journal.

34%

Materials: properties, characterization or tools
Features the measurement of properties intrinsic to the nanoscale, and those techniques devised to characterize materials at this scale. This section is also intended for articles concerned with the understanding and prediction of properties through theoretical and computer modelling.

15%

Materials: synthesis or self-assembly
Presents the fabrication and growth of materials with nanoscale precision and control. Papers should include more than direct material synthesis and characterization, focusing in addition upon methodology, assembly or application-directed synthesis.

15%

Electronics and photonics
Features materials and fabrication technologies for nanodevices, novel electronic and photonic phenomena and systems in the mesoscopic and nanoscale regimes, and their applications. This section also includes aspects of quantum science and technology.

12%

Patterning and nanofabrication
Presents novel processing methods with nanometre resolution. Topics include the assembly of inorganic and organic nanomaterials, electron and ion beam induced nanopatterning, modifications of nanomaterial properties and new applications based on these materials.

8%

Sensing and actuating
Includes a range of detection methods sensitive to the nanoscale able to enhance and convey information to a macroscopic scale. Articles display a significant enhancement of the sensing capabilities of applied nano systems or report upon applications in the field.

8%

Energy at the nanoscale
Reports on the technological aspects and fundamental science associated with innovations in the energy industry that exploit the properties of nanoscale structures. Focuses on nanostructures that can be applied to energy conversion, generation and storage.

8%

Biology and medicine
Features a range of disciplines concerning nano biomedicine. Including, but not limited to, tissue engineering, the conjugation and manipulation of biomolecules to tailored substrates, nanoparticles for targeted drug release and imaging at the single molecule level.

Research papers

Nanotechnology publishes papers at the forefront of nanoscale science and technology, and especially those of an interdisciplinary nature. Submissions should contain significant and original new science, and make substantial advances in nanoscience.

Xiaolong Liu
The United Innovation of Mengchao Hepatobiliary Technology Key Laboratory of Fujian Province

Jingfeng Liu
The United Innovation of Mengchao Hepatobiliary Technology Key Laboratory of Fujian Province

Nanocluster of superparamagnetic iron oxide nanoparticles coated with poly (dopamine) for magnetic field-targeting, highly sensitive MRI and photothermal cancer therapy

Ming Wu, Da Zhang, Yongyi Zeng, Lingjie Wu, Xiaolong Liu and Jingfeng Liu
2015 *Nanotechnology* **26** 115102

Abstract

In this paper, a core–shell nanocomposite of clusters of superparamagnetic iron oxide nanoparticles coated with poly(dopamine) (SPION clusters@PDA) is fabricated as a magnetic field-directed theranostic agent that combines the capabilities of highly sensitive magnetic resonance imaging (MRI) and photothermal cancer therapy. The highly concentrated SPION cluster core is suitable for sensitive MRI due to its superparamagnetic properties, and the poly(dopamine) coating layer can induce cancer cell death under near-infrared (NIR) laser irradiation because of the photothermal conversion ability of PDA. MRI scanning reveals that the nanocomposite has relatively high r_2 and r_2* relaxivities, and the r_2* values are nearly threefold higher than the r_2 values because of the clustering of the SPIONs in the nanocomposite core. Due to the rapid response to magnetic field gradients, enhanced cellular uptake of our nanocomposite mediated by an external magnetic field can be achieved, thus producing significantly enhanced local photothermal killing efficiency against cancer cells under NIR irritation.

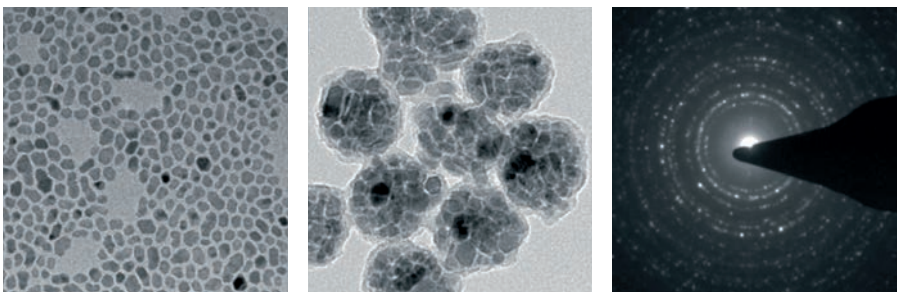


Figure 2 from **Ming Wu, Da Zhang, Yongyi Zeng, Lingjie Wu, Xiaolong Liu and Jingfeng Liu** 2015 *Nanotechnology* **26** 115102

Jin-Wu Jiang
Shanghai Institute of Applied Mathematics and Mechanics

Thermal conduction in single-layer black phosphorus: highly anisotropic?

Jin-Wu Jiang
2015 *Nanotechnology* **26** 055701

Abstract

The single-layer black phosphorus is characteristic for its puckered structure, which has led to distinct anisotropy in its optical, electronic, and mechanical properties. We use the non-equilibrium Green's function approach and the first-principles method to investigate the thermal conductance for single-layer black phosphorus in the ballistic transport regime, in which the phonon–phonon scattering is neglected. We find that the anisotropy in the thermal conduction is very weak for the single-layer black phosphorus—the difference between two in-plane directions is less than 4%. Our phonon calculations disclose that the out-of-plane acoustic phonon branch has lower group velocities in the direction perpendicular to the pucker, as the black phosphorus is softer in this direction, leading to a weakening effect for the thermal conductance in the perpendicular direction. However, the longitudinal acoustic phonon branch behaves abnormally; i.e., the group velocity of this phonon branch is higher in the perpendicular direction, although the single-layer black phosphorus is softer in this direction. The abnormal behavior of the longitudinal acoustic phonon branch is closely related to the highly anisotropic Poisson's ratio in the single-layer black phosphorus. As a result of the counteraction between the out-of-plane phonon mode and the in-plane phonon modes, the thermal conductance in the perpendicular direction is weaker than the parallel direction, but the anisotropy is pretty small.

Diana Grishina
University of Twente

Willem Vos
University of Twente

Method for making a single-step etch mask for 3D monolithic nanostructures

D A Grishina, C A M Harteveld, L A Woldering and W L Vos
2015 *Nanotechnology* **26** 505302

Abstract

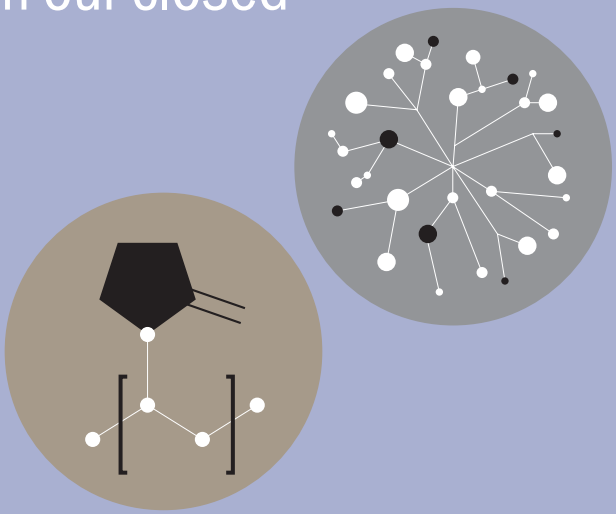
Current nanostructure fabrication by etching is usually limited to planar structures as they are defined by a planar mask. The realization of three-dimensional (3D) nanostructures by etching requires technologies beyond planar masks. We present a method for fabricating a 3D mask that allows one to etch three-dimensional monolithic nanostructures using only CMOS-compatible processes. The mask is written in a hard-mask layer that is deposited on two adjacent inclined surfaces of a Si wafer. By projecting in a single step two different 2D patterns within one 3D mask on the two inclined surfaces, the mutual alignment between the patterns is ensured. Thereby after the mask pattern is defined, the etching of deep pores in two oblique directions yields a three-dimensional structure in Si. As a proof of concept we demonstrate 3D mask fabrication for three-dimensional diamond-like photonic band gap crystals in silicon. The fabricated crystals reveal a broad stop gap in optical reflectivity measurements. We propose how 3D nanostructures with five different Bravais lattices can be realized, namely cubic, tetragonal, orthorhombic, monoclinic and hexagonal, and demonstrate a mask for a 3D hexagonal crystal. We also demonstrate the mask for a diamond-structure crystal with a 3D array of cavities. In general, the 2D patterns on the different surfaces can be completely independently structured and still be in perfect mutual alignment. Indeed, we observe an alignment accuracy of better than 3.0 nm between the 2D mask patterns on the inclined surfaces, which permits one to etch well-defined monolithic 3D nanostructures.

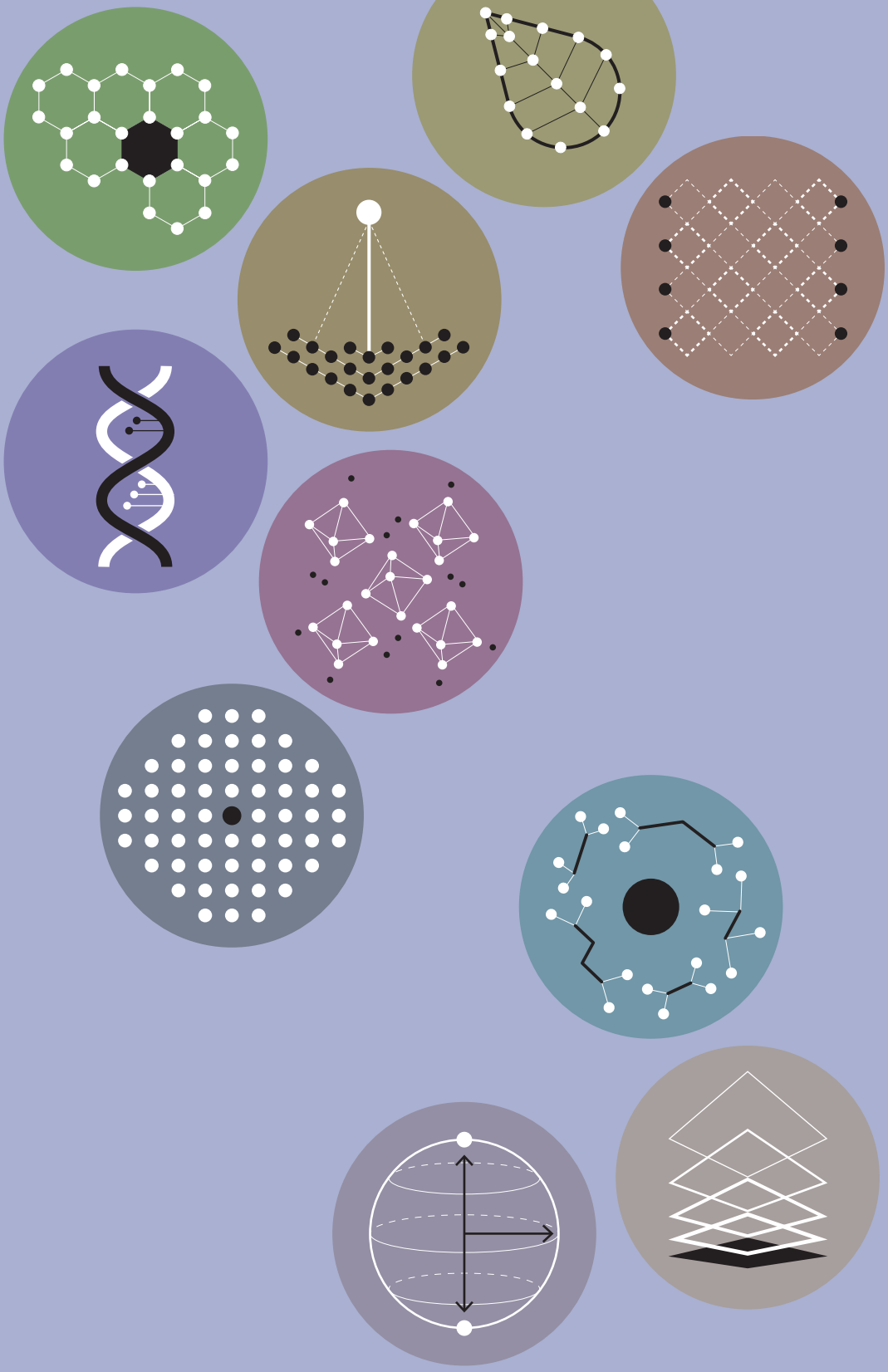
Focus Collections

iopscience.org/nano/focus-collections

Our Focus Collections comprise a diverse selection of exclusive articles, each serving to highlight exciting work conducted in active areas of particular current interest. Leading researchers act as Guest Editors to these high-impact Focus Collections.

Look inside for details on some of our ongoing Focus Collections with highlights from our closed collections.

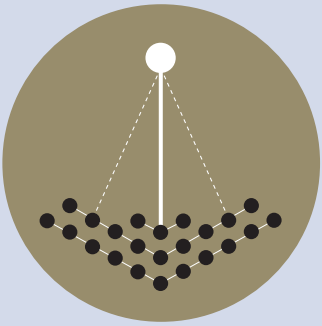




3D Printing

Guest Editors
Madhusudan Singh and
Ghassan Jabbour

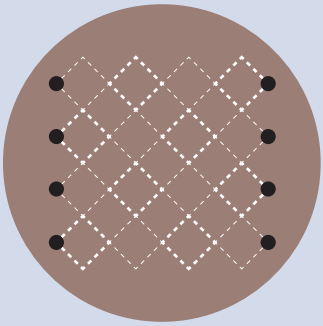
3D printing methods have received a great deal of attention in the last few years as some of the constituent technologies have matured, and some long-standing patents expired, enabling hobbyist use. The focus of this collection is on scientific and engineering advances that have been demonstrated, and in turn, promise to contribute significantly to many areas of everyday life.



Scanning Probe Microscopy

Guest Editors
Johannes Barth, Franz Giessibl
and Rodolfo Miranda

This scope of this Focus Collection extends to all areas of SPM and STM, including established techniques, as well as new and novel ones. This includes findings in the areas of materials science, semiconductor science, and biological sciences, as well as developments to instrumentation and detection methods, theoretical findings, high-speed AFM and more.



Metamaterials

Guest Editors
Anatoly Zayats and Stefan Maier

The Focus Collection is aimed at providing a collection of contributions that describe recent progress in the development of metamaterials and their applications, specifically relating to the designs at the nanoscale. Topics of interest include, plasmonic, dielectric and semi-conductor metamaterials as well as new fabrication approaches for metamaterials.

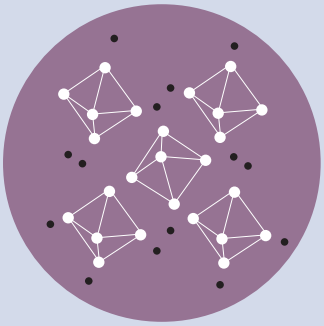
Focus Collections in *Nanotechnology*

> *The strong response to this Focus Collection is a sign that single-molecule, nanotechnology-based devices are up and coming, and will make important contributions to precision medicine in the coming years.*
>
> **Stuart Lindsay**, Arizona State University,
> Guest Editor of Focus on DNA Sequencing

RNAi Delivery

Guest Editors
Dan Peer and Jeff Karp

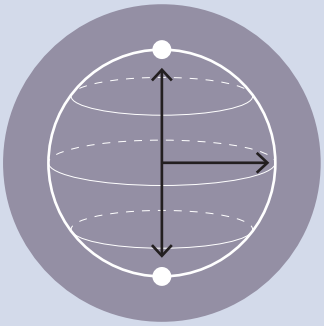
The scope of this Focus Collection predominantly covers RNAi interference but more generally concerns the future of molecular medicine. Specific challenges include cell-specific targeting of nanoscale RNAi delivery systems, as well as amphiphilic micelles for siRNA delivery, and endosomal escape.



Perovskite Solar Cells

Guest Editors
Tze-Chien Sum and Nam-Gyu Park

This Focus Collection aims to highlight the recent progress in the synthesis, preparation and characterization studies of perovskite-based solar cells. It also aims to showcase the wide array of experimental, theoretical and computational tools available to cross-discipline researchers to tackle the challenges in the field.



Quantum Information Processing

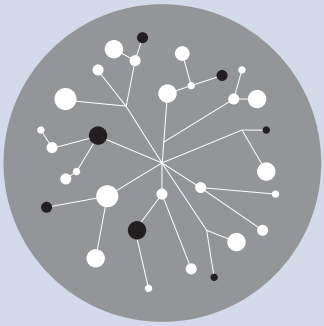
Guest Editors
Jonathan Baugh and Xuedong Hu

The aim of this collection is to capture the latest advances in solid-state systems for quantum information processing and quantum communication. The focus is on meso- and nanoscale devices and structures that host, measure and control qubits or other quantum states useful for quantum information processing.

Benefits of publishing in a Focus Collection

- Articles are added to the collection on an ongoing basis, eliminating publication delay.
- Articles often benefit from additional promotion such as editorials and webinars.
- All articles are freely available to read online for 90 days.
- Articles are subject to rapid peer review from expert referees and Guest Editors.
- Each Focus Collection has its own dedicated webpage that features all articles published.

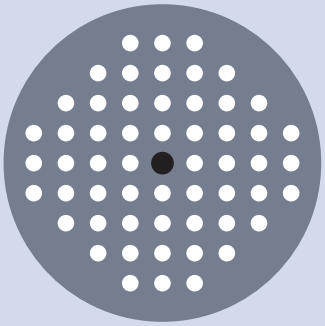
The majority of Focus Collection articles are invited, but we do also encourage non-commissioned contributions. If you believe that you have a suitable article in preparation please send your pre-submission query to **nano@iop.org**.



Big, Deep and Smart Data in Nanotechnology

Guest Editors
Sergei Kalinin, Bobby Sumpter and Ichiro Takeuchi

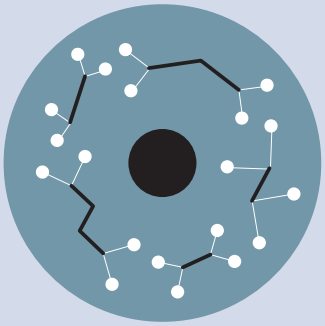
This collection captures the recent advances in the application of big data to materials science. This is in terms of the output of imaging, theoretical, computational and synthesis tools to physically and chemically relevant information, and establishing synergies across the field.



Sub-10nm Nanofabrication

Guest Editor
Michele Perego

An extensive and complete overview of current nanofabrication approaches, discussing their present limitations and future developments. We cover all the scientific and technological aspects related to the fabrication of nanostructures, offering the possibility to dispatch recent experimental and theoretical results about the development of key enabling technologies for the manipulation of matter at the nanoscale.



Biosensing

Guest Editors
Logan Liu, Frank Vollmer and Xianqiang Mi

This Focus Collection centres on the rapidly blossoming field of biosensing, with a particular focus on the use of nanotechnology to facilitate research within this area. The scope of the collection will cover the broad range of biosensing techniques currently ongoing covering the following domains: optical, electrical and mechanical.

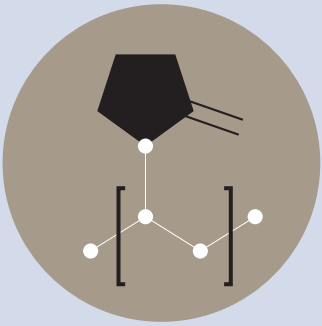
Highlights from closed Focus Collections

FOCUS ON DNA SEQUENCING

1/f noise in graphene nanopores

S J Heerema, G F Schneider, M Rozemuller, L Vicarelli, H W Zandbergen and C Dekker 2015 *Nanotechnology* **26** 074001

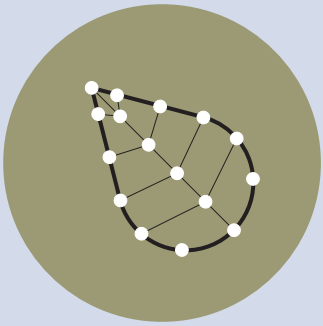
Graphene nanopores receive great attention due to their atomically thin membranes and intrinsic electrical properties that appear greatly beneficial for biosensing and DNA sequencing. Here, we present an extensive study of the low-frequency 1/f noise in the ionic current through graphene nanopores and compare it to noise levels in silicon nitride pore currents. We find that the 1/f noise magnitude is very high for graphene nanopores: typically two orders of magnitude higher than for silicon nitride pores. This is a drawback as it significantly lowers the signal-to-noise ratio in DNA translocation experiments. We evaluate possible explanations for these exceptionally high noise levels. The comparison of single and bilayer graphene to few-layer and multi-layer graphene and boron nitride (h-BN), shows that the noise reduces with layer thickness for both materials, which suggests that mechanical fluctuations may be the underlying cause of the high 1/f noise levels in monolayer graphene nanopore devices.



Chemical Imaging

Guest Editors
Olga Ovchinnikova, Albina Borisevicy and Tessa Calhoun

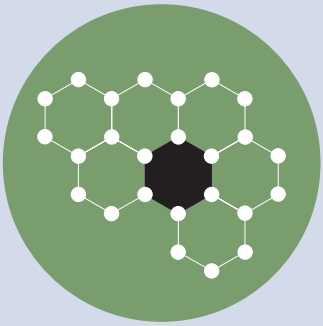
This Focus Collection brings together the important chemical imaging techniques that are being developed to provide a clear and accurate view at the nanometre-scale. Techniques that are featured include nonlinear optical microscopy, multimodal chemical imaging, near-field optical microscopy, ambient surface analysis and coupling techniques for optical and electron microscopies.



The Lifecycle of Nanomaterials

Guest Editors
Boris Lau, Jessica D Schiffman and Weile Yan

The commercialization of nanotechnology is leading to greater incorporation of nanoparticles into our everyday items, such as electronic devices, clothing, and textiles. This collection will focus on two key areas concerning the lifecycle of nanomaterials, the synthesis of nanomaterials, and the fate and transport of nanomaterials released into the natural environment or engineering treatment facilities.



Nanotechnology for Aerospace

Guest Editors
Debbie G Senesky and Jessica E Koehne

The harsh space environment and extreme costs of space missions place new demands on materials and electronics used in aerospace systems. This has led engineers and scientists to identify new material and electronic platforms that can operate under extreme radiation and temperature swings with reduced payloads.

FOCUS ON ATOMIC LAYER DEPOSITION IN ENERGY, ENVIRONMENT, AND SUSTAINABILITY

Applications of atomic layer deposition in solar cells

Wenbin Niu, Xianglin Li, Siva Krishna Karuturi, Derrick Wenhui Fam, Hongjin Fan, Santosh Shrestha, Lydia Helena Wong and Alfred Iing Yoong Tok 2015 *Nanotechnology* **26** 064001

Atomic layer deposition (ALD) provides a unique tool for the growth of thin films with excellent conformity and thickness control down to atomic levels. The application of ALD in energy research has received increasing attention in recent years. In this review, the versatility of ALD in solar cells will be discussed. This is specifically focused on the fabrication of nanostructured photoelectrodes, surface passivation, surface sensitization, and band-structure engineering of solar cell materials. Challenges and future directions of ALD in the applications of solar cells are also discussed.

Nanotechnology Select

Nanotechnology Select highlights the very best research published in *Nanotechnology*. Articles, from all areas of nanoscale research, are selected by the Editors for their innovation, scientific rigour, and high impact in their respective fields.

Yu Jing
Nankai University

Zhen Zhou
Nankai University

Small molecules make big differences: molecular doping effects on electronic and optical properties of phosphorene

Yu Jing, Qing Tang, Peng He, Zhen Zhou and Panwen Shen
2015 *Nanotechnology* **26** 095201

Abstract
Systematical computations on the density functional theory were performed to investigate the adsorption of three typical organic molecules, tetracyanoquinodimethane (TCNQ), tetracyanoethylene (TCNE) and tetrathiafulvalene (TTF), on the surface of phosphorene monolayers and thicker layers. There exist considerable charge transfer and strong non-covalent interaction between these molecules and phosphorene. In particular, the band gap of phosphorene decreases dramatically due to the molecular modification and can be further tuned by applying an external electric field. Meanwhile, surface molecular modification has proven to be an effective way to enhance the light harvesting of phosphorene in different directions. Our results predict a flexible method toward modulating the electronic and optical properties of phosphorene and shed light on its experimental applications.

K Christian Kemp
Ulsan National Institute of Science and Technology

Kwang S Kim
Ulsan National Institute of Science and Technology

Activated carbon derived from waste coffee grounds for stable methane storage

K Christian Kemp, Seung Bin Baek, Wang-Geun Lee, M Meyyappan and Kwang S Kim
2015 *Nanotechnology* **26** 385602

Abstract
An activated carbon material derived from waste coffee grounds is shown to be an effective and stable medium for methane storage. The sample activated at 900 °C displays a surface area of 1040.3 $m^2 g^{-1}$ and a micropore volume of 0.574 $cm^3 g^{-1}$ and exhibits a stable CH_4 adsorption capacity of ~4.2 mmol g^{-1} at 3.0 MPa and a temperature range of 298 ± 10 K. The same material exhibits an impressive hydrogen storage capacity of 1.75 wt% as well at 77 K and 100 kPa. Here, we also propose a mechanism for the formation of activated carbon from spent coffee grounds. At low temperatures, the material has two distinct types with low and high surface areas; however, activation at elevated temperatures drives off the low surface area carbon, leaving behind the porous high surface area activated carbon.

Perspectives

Perspective articles are commissioned commentaries authored by researchers in the nanotechnology community, aimed at highlighting the significance, impact and wider implications of research appearing in *Nanotechnology*.

Jiahao Kang
University of California

Quantum capacitance measurement for a black phosphorus field-effect transistor

Jiahao Kang
2016 *Nanotechnology* **27** 042501

Abstract

The unique electrical, optical and thermal properties of black phosphorus have triggered the development of black phosphorus transistors as well as a wide range of other relevant applications. However, there are still challenges in understanding and modeling gated black phosphorus, among which the exploration of quantum capacitance is crucial. Understanding quantum capacitance requires specified measurements other than typical characterizations done before for black phosphorus transistors. Recently, Kuiri *et al* (*Nanotechnology* **26** 485704) reported the quantum capacitance measured on few layer black phosphorus and its difference compared to that from conductance measurement. Localized states near the band edge were observed by the capacitance measurement, which was considered as the main reason for the difference. The new findings provide guidelines for theoretical understanding and modeling of black phosphorus devices.

The above perspective was commissioned on an article featured in *Nanotechnology* Select (**Manabendra Kuiri *et al*** 2015 *Nanotechnology* **26** 485704).

Letters

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SeungYeon Kang
Harvard University

Eric Mazur
Harvard University

One-step direct-laser metal writing of sub-100 nm 3D silver nanostructures in a gelatin matrix

SeungYeon Kang, Kevin Vora and Eric Mazur
2015 *Nanotechnology* **26** 121001

Abstract
Developing a fabrication method for high-resolution, 3D metal nanostructures in a stretchable 3D matrix is a critical step to realizing novel optoelectronic devices such as tunable bulk metal/dielectric optical devices and THz metamaterial devices. We report a new chemistry method to fabricate sub-micron, 3D silver nanostructures using a femtosecond-laser direct metal writing technique. Our method takes advantage of unique gelatin properties to overcome previous limitations such as limited freedom in 3D design and short sample lifetime. We fabricate more than 15 layers of 3D nanostructures in a single-step with a resolution of less than 100 nm in a flexible dielectric matrix which exhibits high transparency for potential applications in the optical and THz metamaterial regimes. This technique will be of interest to those developing fabrication methods that utilize nonlinear light–matter interactions and the realization of future metamaterials.

Manitha Nair
Amrita Institute of Medical Sciences & Research Centre

Sajini Vadukumpully
Amrita Institute of Medical Sciences & Research Centre

Graphene oxide nanoflakes incorporated gelatin–hydroxyapatite scaffolds enhance osteogenic differentiation of human mesenchymal stem cells

Manitha Nair, D Nancy, Amit G Krishnan, G S Anjusree, Sajini Vadukumpully and Shantikumar V Nair
2015 *Nanotechnology* **26** 161001

Abstract
In this study, graphene oxide (GO) nanoflakes (0.5 and 1 wt%) were incorporated into a gelatin–hydroxyapatite (GHA) matrix through a freeze drying technique and its effect to enhance mechanical strength and osteogenic differentiation was studied. The GHA matrix with GO demonstrated less brittleness in comparison to GHA scaffolds. When the scaffolds were immersed in phosphate buffered saline for 60 days, around 50–60% of GO was released in sustained and linear manner and the concentration was within the toxicity limit. Further, $GOGHA_{0.5}$ scaffolds, wherein the scaffold induced osteogenic differentiation of human adipose derived mesenchymal stem cells without providing supplements like dexamethasone, L-ascorbic acid and β glycerophosphate in the medium. The level of osteogenic differentiation of stem cells was comparable to those cultured on GHA scaffolds with osteogenic supplements. Thus biocompatible, biodegradable and porous GO reinforced gelatin–HA 3D scaffolds may serve as a suitable candidate in promoting bone regeneration in orthopaedics.

Topical Reviews

The Editorial Board regularly identifies fields of current interest and commissions reviews in those areas. These reviews provide a brief overview of a rapidly developing field and are aimed at being interesting and informative for specialists and non-specialists alike.

Miran Mozetič
Jozef Stefan Institute

Aleš Iglič
University of Ljubljana

Titanium nanostructures for biomedical applications

M Kulkarni, A Mazare, E Gongadze, Š Perutkova, V Kralj-Iglič, I Milošev, P Schmuki, A Iglič and M Mozetič
2015 *Nanotechnology* **26** 062002

Abstract
Titanium and titanium alloys exhibit a unique combination of strength and biocompatibility, which enables their use in medical applications, especially as implant materials. Extensive research is being carried out in order to determine the optimal surface topography for use in bioapplications. Titanium implants with rough surface topography and high free energy increase osteoblast adhesion, maturation and subsequent bone formation. Furthermore, the adhesion of different cells to the surface of titanium implants is influenced by the surface topography, charge distribution and chemistry. The review article focuses on titanium dioxide (TiO_2) nanotubes synthesized by electrochemical anodisation, hydrothermal processes or sol-gel template. The TiO_2 nanotube morphology is correlated with cell adhesion, spreading, growth and differentiation of mesenchymal stem cells, which were shown to be maximally induced on smaller diameter nanotubes (15 nm), but hindered on larger diameter (100 nm) tubes. The review focuses also on increased osseointegration, protein interaction and antibacterial properties.

Spencer Carson
Northeastern University

Meni Wanunu
Northeastern University

Challenges in DNA motion control and sequence readout using nanopore devices

Spencer Carson and Meni Wanunu
2015 *Nanotechnology* **26** 074004

Abstract
Nanopores are being hailed as a potential next-generation DNA sequencer that could provide cheap, high-throughput DNA analysis. In this review we present a detailed summary of the various sensing techniques being investigated for use in DNA sequencing and mapping applications. A crucial impasse to the success of nanopores as a reliable DNA analysis tool is the fast and stochastic nature of DNA translocation. We discuss the incorporation of biological motors to step DNA through a pore base-by-base, as well as the many experimental modifications attempted for the purpose of slowing and controlling DNA transport.

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