

# 图书情报专题研究

最新学科研究热点与前沿  
( 2021 )

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2021 年 6 月

# 前 言

《图书情报专题研究》的宗旨是为我校师生开展学术研究提供有价值的参考信息，此项工作由图书馆信息咨询服务部承担。“最新学科研究热点与前沿”根据学校所购买的数字资源，通过分析其深层次的功能，从数据库中组织整理出了与我校学科领域相关的最新学科热点研究论文、最新研究前沿及最新国际会议信息等，以期能对我校师生开展学术研究、项目立项、开题等学术研究活动提供帮助。

本期收集整理如下七个方面的热点文献和前沿信息：

1、Nature Latest Research, , Nature Materials 最新研究进展；

2、IEL Top25, IEL 数据库下载最多的 25 篇论文；

3、ESI (Essential Science Indicators) HOT PAPERS, 按照 ESI 某一学科热点论文被引频次排名选取前 25 篇；

4、ESI (Essential Science Indicators) HIGHLY CITED PAPERS, 按照 ESI 某一学科高被引论文被引频次排名选取前 25 篇；

5、AIAA、IAF 最新会议，由 AIAA、IAF 主站提供的最新会议信息，可供相关研究者参考；

6、ACM 最新会议，根据 ACM 主页所提供的最新会议信息整理所得，可供相关研究者参考；

7、IQPC 最新会议，由国际质量与竞争力中心 (IQPC: International Quality and Productivity Center) 提供的最新国际会议，内容涉及国防、能源、工业、科技、电信等领域。IQPC 是国际顶级的会议展览策划公司，于 1973 年成立于美国，旨在为全球业务主管提供量身定制的会议、大型会展以及培训课程，积极为行业人士的相互交流创建平台，使业内人士能够随时掌握行业发展的最新趋势及技术创新。

如果您对我们的栏目设置、内容编排等有好的意见和建议，欢迎与我们联系 (电话：88492928)，我们将积极采纳，使这份电子刊物日臻完善，共同为把我校建成学科特色鲜明的世界一流大学而努力。

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2021 年 6 月



## 目 录

一、NatureLatest Research(Materials) .....	1
二、IEL Top25 .....	10
三、ESI HOT PAPERS (Materials Science) .....	23
四、ESI HIGHLY CITED PAPERS (Materials Science) .....	40
五、AIAA、IAF 最新会议 .....	54
六、ACM 最新会议 .....	57
七、IQPC 最新国防会议(Defence) .....	61



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## *NatureLatest Research(Materials)*

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来源: <https://www.nature.com/nphys/research>

1. 标题: Supersonic impact resilience of nanoarchitected carbon

作者: Carlos M. Portela, Bryce W. Edwards, David Veysset, Yuchen Sun, Keith A. Nelson, Dennis M. Kochmann & Julia R. Greer

摘要: Architected materials with nanoscale features have enabled extreme combinations of properties by exploiting the ultralightweight structural design space together with size-induced mechanical enhancement at small scales. Apart from linear waves in metamaterials, this principle has been restricted to quasi-static properties or to low-speed phenomena, leaving nanoarchitected materials under extreme dynamic conditions largely unexplored. Here, using supersonic microparticle impact experiments, we demonstrate extreme impact energy dissipation in three-dimensional nanoarchitected carbon materials that exhibit mass-normalized energy dissipation superior to that of traditional impact-resistant materials such as steel, aluminium, polymethyl methacrylate and Kevlar. In-situ ultrahigh-speed imaging and post-mortem confocal microscopy reveal consistent mechanisms such as compaction cratering and microparticle capture that enable this superior response. By analogy to planetary impact, we introduce predictive tools for crater formation in these materials using dimensional analysis. These results substantially uncover the dynamic regime over which nanoarchitecture enables the design of ultralightweight, impact-resistant materials that could open the way to design principles for lightweight armour, protective coatings and blast-resistant shields for sensitive electronics.

链接: <https://www.nature.com/articles/s41563-021-01033-z>

2. 标题: Centimetre-scale crack-free self-assembly for ultra-high tensile strength metallic nanolattices

作者: Zhimin Jiang & James H. Pikul

摘要: Nanolattices exhibit attractive mechanical, energy conversion and optical properties, but it is challenging to fabricate large nanolattices while maintaining the dense regular nanometre features that enable their properties. Here we report a crack-free self-assembly approach for fabricating centimetre-scale nickel nanolattices with much larger crack-free areas than prior self-assembled nanolattices and many more unit cells than three-dimensionally printed nanolattices. These nickel nanolattices have a feature size of 100 nm, a grain size of 30 nm and a tensile strength of 260 MPa, which approaches the theoretical strength limit for porous nickel. The self-assembly method and porous metal mechanics reported in this work may advance the fabrication and applications of high-strength multifunctional porous materials.

链接: <https://www.nature.com/articles/s41563-021-01039-7>

3. **标题:** Programmable icosahedral shell system for virus trapping  
**作者:** Christian Sigl, Elena M. Willner, Wouter Engelen, Jessica A. Kretzmann, Ken Sachenbacher, Anna Liedl, Fenna Kolbe, Florian Wilsch, S. Ali Aghvami, Ulrike Protzer, Michael F. Hagan, Seth Fraden & Hendrik Dietz  
**摘要:** Broad-spectrum antiviral platforms that can decrease or inhibit viral infection would alleviate many threats to global public health. Nonetheless, effective technologies of this kind are still not available. Here, we describe a programmable icosahedral canvas for the self-assembly of icosahedral shells that have viral trapping and antiviral properties. Programmable triangular building blocks constructed from DNA assemble with high yield into various shell objects with user-defined geometries and apertures. We have created shells with molecular masses ranging from 43 to 925 MDa (8 to 180 subunits) and with internal cavity diameters of up to 280 nm. The shell interior can be functionalized with virus-specific moieties in a modular fashion. We demonstrate this virus-trapping concept by engulfing hepatitis B virus core particles and adeno-associated viruses. We demonstrate the inhibition of hepatitis B virus core interactions with surfaces in vitro and the neutralization of infectious adeno-associated viruses exposed to human cells.  
**链接:** <https://www.nature.com/articles/s41563-021-01020-4>
4. **标题:** Chemical vapour deposition of Fe–N–C oxygen reduction catalysts with full utilization of dense Fe–N<sub>4</sub> sites  
**作者:** Li Jiao, Jingkun Li, Lynne LaRochelle Richard, Qiang Sun, Thomas Stracensky, Ershuai Liu, Moulay Tahar Sougrati, Zipeng Zhao, Fan Yang, Sichen Zhong, Hui Xu, Sanjeev Mukerjee, Yu Huang, David A. Cullen, Jae Hyung Park, Magali Ferrandon, Deborah J. Myers, Frédéric Jaouen & Qingying Jia  
**摘要:** Replacing scarce and expensive platinum (Pt) with metal–nitrogen–carbon (M–N–C) catalysts for the oxygen reduction reaction in proton exchange membrane fuel cells has largely been impeded by the low oxygen reduction reaction activity of M–N–C due to low active site density and site utilization. Herein, we overcome these limits by implementing chemical vapour deposition to synthesize Fe–N–C by flowing iron chloride vapour over a Zn–N–C substrate at 750 °C, leading to high-temperature trans-metalation of Zn–N<sub>4</sub> sites into Fe–N<sub>4</sub> sites. Characterization by multiple techniques shows that all Fe–N<sub>4</sub> sites formed via this approach are gas-phase and electrochemically accessible. As a result, the Fe–N–C catalyst has an active site density of  $1.92 \times 10^{20}$  sites per gram with 100% site utilization. This catalyst delivers an unprecedented oxygen reduction reaction activity of 33 mA cm<sup>-2</sup> at 0.90 V (iR-corrected; i, current; R, resistance) in a H<sub>2</sub>–O<sub>2</sub> proton exchange membrane fuel cell at 1.0 bar and 80 °C.  
**链接:** <https://www.nature.com/articles/s41563-021-01030-2>
5. **标题:** Random access DNA memory using Boolean search in an archival file storage system  
**作者:** James L. Banal, Tyson R. Shepherd, Joseph Berleant, Hellen Huang, Miguel Reyes, Cheri M. Ackerman, Paul C. Blainey & Mark Bathe  
**摘要:** DNA is an ultrahigh-density storage medium that could meet exponentially growing worldwide demand for archival data storage if DNA synthesis costs declined sufficiently and if random access of files within exabyte-to-yottabyte-scale DNA data pools were feasible. Here, we

demonstrate a path to overcome the second barrier by encapsulating data-encoding DNA file sequences within impervious silica capsules that are surface labelled with single-stranded DNA barcodes. Barcodes are chosen to represent file metadata, enabling selection of sets of files with Boolean logic directly, without use of amplification. We demonstrate random access of image files from a prototypical 2-kilobyte image database using fluorescence sorting with selection sensitivity of one in 10<sup>6</sup> files, which thereby enables one in 10<sup>6</sup>N selection capability using N optical channels. Our strategy thereby offers a scalable concept for random access of archival files in large-scale molecular datasets.

链接: <https://www.nature.com/articles/s41563-021-01021-3>

6. 标题: Band gap engineering in blended organic semiconductor films based on dielectric interactions

作者: Katrin Ortstein, Sebastian Hutsch, Mike Hambsch, Kristofer Tvingstedt, Berthold Wegner, Johannes Benduhn, Jonas Kublitski, Martin Schwarze, Sebastian Schellhammer, Felix Talnack, Astrid Vogt, Peter Bäuerle, Norbert Koch, Stefan C. B. Mannsfeld, Hans Kleemann, Frank Ortmann & Karl Leo

摘要: Blending organic molecules to tune their energy levels is currently being investigated as an approach to engineer the bulk and interfacial optoelectronic properties of organic semiconductors. It has been proven that the ionization energy and electron affinity can be equally shifted in the same direction by electrostatic effects controlled by blending similar halogenated derivatives with different energetics. Here we show that the energy gap of organic semiconductors can also be tuned by blending. We use oligothiophenes with different numbers of thiophene rings as an example and investigate their structure and electronic properties. Photoelectron spectroscopy and inverse photoelectron spectroscopy show tunability of the single-particle gap, with the optical gaps showing similar, but smaller, effects. Theoretical analysis shows that this tuning is mainly caused by a change in the dielectric constant with blend ratio. Further studies will explore the practical impact of this energy-level engineering strategy for optoelectronic devices.

链接: <https://www.nature.com/articles/s41563-021-01025-z>

7. 标题: Thermal chiral anomaly in the magnetic-field-induced ideal Weyl phase of Bi<sub>1-x</sub>Sb<sub>x</sub>

作者: Dung Vu, Wenjuan Zhang, Cüneyt Şahin, Michael E. Flatté, Nandini Trivedi & Joseph P. Heremans

摘要: The chiral anomaly is the predicted breakdown of chiral symmetry in a Weyl semimetal with monopoles of opposite chirality when an electric field is applied parallel to a magnetic field. It occurs because of charge pumping between monopoles of opposite chirality. Experimental observation of this fundamental effect is plagued by concerns about the current pathways. Here we demonstrate the thermal chiral anomaly, energy pumping between monopoles, in topological insulator bismuth–antimony alloys driven into an ideal Weyl semimetal state by a Zeeman field, with the chemical potential pinned at the Weyl points and in the absence of any trivial Fermi surface pockets. The experimental signature is a large enhancement of the thermal conductivity in an applied magnetic field parallel to the thermal gradient. This work demonstrates both pumping of energy and charge between the two Weyl points of opposite chirality and that they are related by the Wiedemann–Franz law.



链接: <https://www.nature.com/articles/s41563-021-00983-8>

8. 标题: Synthetic Rashba spin-orbit system using a silicon metal-oxide semiconductor

作者: Soobom Lee, Hayato Koike, Minori Goto, Shinji Miwa, Yoshishige Suzuki, Naoto Yamashita, Ryo Ohshima, Ei Shigematsu, Yuichiro Ando & Masashi Shiraishi

摘要: The spin-orbit interaction (SOI), mainly manifesting itself in heavy elements and compound materials, has been attracting much attention as a means of manipulating and/or converting a spin degree of freedom. Here, we show that a Si metal-oxide-semiconductor (MOS) heterostructure possesses Rashba-type SOI, although Si is a light element and has lattice inversion symmetry resulting in inherently negligible SOI in bulk form. When a strong gate electric field is applied to the Si MOS, we observe spin lifetime anisotropy of propagating spins in the Si through the formation of an emergent effective magnetic field due to the SOI. Furthermore, the Rashba parameter  $\alpha$  in the system increases linearly up to  $9.8 \times 10^{-16} \text{ eV m}^{-1}$  for a gate electric field of  $0.5 \text{ V nm}^{-1}$ ; that is, it is gate tuneable and the spin splitting of  $0.6 \mu\text{eV}$  is relatively large. Our finding establishes a family of spin-orbit systems.

链接: <https://www.nature.com/articles/s41563-021-01026-y>

9. 标题: A singlet-triplet hole spin qubit in planar Ge

作者: Daniel Jirovec, Andrea Hofmann, Andrea Ballabio, Philipp M. Mutter, Giulio Tavani, Marc Botifoll, Alessandro Crippa, Josip Kukucka, Oliver Sagi, Frederico Martins, Jaime Saez-Mollejo, Ivan Prieto, Maksim Borovkov, Jordi Arbiol, Daniel Chrastina, Giovanni Isella & Georgios Katsaros

摘要: Spin qubits are considered to be among the most promising candidates for building a quantum processor. Group IV hole spin qubits are particularly interesting owing to their ease of operation and compatibility with Si technology. In addition, Ge offers the option for monolithic superconductor-semiconductor integration. Here, we demonstrate a hole spin qubit operating at fields below 10 mT, the critical field of Al, by exploiting the large out-of-plane hole g-factors in planar Ge and by encoding the qubit into the singlet-triplet states of a double quantum dot. We observe electrically controlled g-factor difference-driven and exchange-driven rotations with tunable frequencies exceeding 100 MHz and dephasing times of  $1 \mu\text{s}$ , which we extend beyond  $150 \mu\text{s}$  using echo techniques. These results demonstrate that Ge hole singlet-triplet qubits are competing with state-of-the-art GaAs and Si singlet-triplet qubits. In addition, their rotation frequencies and coherence are comparable with those of Ge single spin qubits, but singlet-triplet qubits can be operated at much lower fields, emphasizing their potential for on-chip integration with superconducting technologies.

链接: <https://www.nature.com/articles/s41563-021-01022-2>

10. 标题: Tension-compression asymmetry in amorphous silicon

作者: Yuecun Wang, Jun Ding, Zhao Fan, Lin Tian, Meng Li, Huanhuan Lu, Yongqiang Zhang, En Ma, Ju Li & Zhiwei Shan

摘要: Hard and brittle materials usually exhibit a much lower strength when loaded in tension than in compression. However, this common-sense behaviour may not be intrinsic to these materials, but arises from their higher flaw sensitivity to tensile loading. Here, we demonstrate a

reversed and unusually pronounced tension–compression asymmetry (tensile strength exceeds compressive strength by a large margin) in submicrometre-sized samples of isotropic amorphous silicon. The abnormal asymmetry in the yield strength and anelasticity originates from the reduction in shear modulus and the densification of the shear-activated configuration under compression, altering the magnitude of the activation energy barrier for elementary shear events in amorphous Si. In situ coupled electrical tests corroborate that compressive strains indeed cause increased atomic coordination (metallization) by transforming some local structures from sp<sup>3</sup>-bonded semiconducting motifs to more metallic-like sites, lending credence to the mechanism we propose. This finding opens up an unexplored regime of intrinsic tension–compression asymmetry in materials.

链接: <https://www.nature.com/articles/s41563-021-01017-z>

11. 标题: Oxygen-evolving catalytic atoms on metal carbides

作者: Shuang Li, Bingbing Chen, Yi Wang, Meng-Yang Ye, Peter A. van Aken, Chong Cheng & Arne Thomas

摘要: Single-atom catalysts have shown promising performance in various catalytic reactions. Catalytic metal sites supported on oxides or carbonaceous materials are usually strongly coordinated by oxygen or heteroatoms, which naturally affects their electronic environment and consequently their catalytic activity. Here, we reveal the stabilization of single-atom catalysts on tungsten carbides without the aid of heteroatom coordination for efficient catalysis of the oxygen evolution reaction (OER). Benefiting from the unique structure of tungsten carbides, the atomic FeNi catalytic sites are weakly bonded with the surface W and C atoms. The reported catalyst shows a low overpotential of 237 mV at 10 mA cm<sup>-2</sup>, which can even be lowered to 211 mV when the FeNi content is increased, a high turnover frequency value of 4.96 s<sup>-1</sup> ( $\eta = 300$  mV) and good stability (1,000 h). Density functional theory calculations show that either metallic Fe/Ni atoms or (hydro)oxide FeNi species are responsible for the high OER activity. We suggest that the application of inexpensive and durable WC<sub>x</sub> supports opens up a promising pathway to develop further single-atom catalysts for electrochemical catalytic reactions

链接: <https://www.nature.com/articles/s41563-021-01006-2>

12. 标题: Visualization of the strain-induced topological phase transition in a quasi-one-dimensional superconductor TaSe<sub>3</sub>

作者: Chun Lin, Masayuki Ochi, Ryo Noguchi, Kenta Kuroda, Masahito Sakoda, Atsushi Nomura, Masakatsu Tsubota, Peng Zhang, Cedric Bareille, Kifu Kurokawa, Yosuke Arai, Kaishu Kawaguchi, Hiroaki Tanaka, Koichiro Yaji, Ayumi Harasawa, Makoto Hashimoto, Donghui Lu, Shik Shin, Ryotaro Arita, Satoshi Tanda & Takeshi Kondo

摘要: Control of the phase transition from topological to normal insulators can allow for an on/off switching of spin current. While topological phase transitions have been realized by elemental substitution in semiconducting alloys, such an approach requires preparation of materials with various compositions. Thus it is quite far from a feasible device application, which demands a reversible operation. Here we use angle-resolved photoemission spectroscopy and spin- and angle-resolved photoemission spectroscopy to visualize the strain-driven band-structure evolution of the quasi-one-dimensional superconductor TaSe<sub>3</sub>. We demonstrate that it undergoes reversible



strain-induced topological phase transitions from a strong topological insulator phase with spin-polarized, quasi-one-dimensional topological surface states, to topologically trivial semimetal and band insulating phases. The quasi-one-dimensional superconductor TaSe<sub>3</sub> provides a suitable platform for engineering the topological spintronics, for example as an on/off switch for a spin current that is robust against impurity scattering.

链接: <https://www.nature.com/articles/s41563-021-01004-4>

13. 标题: Quantifying charge carrier localization in chemically doped semiconducting polymers  
作者: Shawn A. Gregory, Riley Hanus, Amalie Atassi, Joshua M. Rinehart, Jamie P. Wooding, Akanksha K. Menon, Mark D. Losego, G. Jeffery Snyder & Shannon K. Yee

摘要: Charge transport in semiconducting polymers ranges from localized (hopping-like) to delocalized (metal-like), yet no quantitative model exists to fully capture this transport spectrum and its dependency on charge carrier density. In this study, using an archetypal polymer-dopant system, we measure the temperature-dependent electrical conductivity, Seebeck coefficient and extent of oxidation. We then use these measurements to develop a semi-localized transport (SLoT) model, which captures both localized and delocalized transport contributions. By applying the SLoT model to published data, we demonstrate its broad utility. We are able to determine system-dependent parameters such as the maximum localization energy of the system, how this localization energy changes with doping, the amount of dopant required to achieve metal-like conductivity and the conductivity a system could have in the absence of localization effects. This proposed SLoT model improves our ability to predict and tailor electronic properties of doped semiconducting polymers.

链接: <https://www.nature.com/articles/s41563-021-01008-0>

14. 标题: Revealing the role of the cathode-electrolyte interface on solid-state batteries  
作者: Beniamin Zahiri, Arghya Patra, Chadd Kiggins, Adrian Xiao Bin Yong, Elif Ertekin, John B. Cook & Paul V. Braun

摘要: Interfaces have crucial, but still poorly understood, roles in the performance of secondary solid-state batteries. Here, using crystallographically oriented and highly faceted thick cathodes, we directly assess the impact of cathode crystallography and morphology on the long-term performance of solid-state batteries. The controlled interface crystallography, area and microstructure of these cathodes enables an understanding of interface instabilities unknown (hidden) in conventional thin-film and composite solid-state electrodes. A generic and direct correlation between cell performance and interface stability is revealed for a variety of both lithium- and sodium-based cathodes and solid electrolytes. Our findings highlight that minimizing interfacial area, rather than its expansion as is the case in conventional composite cathodes, is key to both understanding the nature of interface instabilities and improving cell performance. Our findings also point to the use of dense and thick cathodes as a way of increasing the energy density and stability of solid-state batteries.

链接: <https://www.nature.com/articles/s41563-021-01016-0>



15. **标题:** Chiral-spin rotation of non-collinear antiferromagnet by spin-orbit torque  
**作者:** Yutaro Takeuchi, Yuta Yamane, Ju-Young Yoon, Ryuichi Itoh, Butsurin Jinnai, Shun Kanai, Jun'ichi Ieda, Shunsuke Fukami & Hideo Ohno  
**摘要:** Electrical manipulation of magnetic materials by current-induced spin torque constitutes the basis of spintronics. Here, we show an unconventional response to spin-orbit torque of a non-collinear antiferromagnet Mn<sub>3</sub>Sn, which has attracted attention owing to its large anomalous Hall effect despite a vanishingly small net magnetization. In epitaxial heavy-metal/Mn<sub>3</sub>Sn heterostructures, we observe a characteristic fluctuation of the Hall resistance under the application of electric current. This observation is explained by a rotation of the chiral-spin structure of Mn<sub>3</sub>Sn driven by spin-orbit torque. We find that the variation of the magnitude of anomalous Hall effect fluctuation with sample size correlates with the number of magnetic domains in the Mn<sub>3</sub>Sn layer. In addition, the dependence of the critical current on Mn<sub>3</sub>Sn layer thickness reveals that spin-orbit torque generated by small current densities, below 20 MA cm<sup>-2</sup>, effectively acts on the chiral-spin structure even in Mn<sub>3</sub>Sn layers that are thicker than 20 nm. The results provide additional pathways for electrical manipulation of magnetic materials.

**链接:** <https://www.nature.com/articles/s41563-021-01005-3>

16. **标题:** Bosonic condensation of exciton-polaritons in an atomically thin crystal  
**作者:** Carlos Anton-Solanas, Maximilian Waldherr, Martin Klaas, Holger Suchomel, Tristan H. Harder, Hui Cai, Evgeny Sedov, Sebastian Klembt, Alexey V. Kavokin, Sefaattin Tongay, Kenji Watanabe, Takashi Taniguchi, Sven Höfling & Christian Schneider  
**摘要:** The emergence of two-dimensional crystals has revolutionized modern solid-state physics. From a fundamental point of view, the enhancement of charge carrier correlations has sparked much research activity in the transport and quantum optics communities. One of the most intriguing effects, in this regard, is the bosonic condensation and spontaneous coherence of many-particle complexes. Here we find compelling evidence of bosonic condensation of exciton-polaritons emerging from an atomically thin crystal of MoSe<sub>2</sub> embedded in a dielectric microcavity under optical pumping at cryogenic temperatures. The formation of the condensate manifests itself in a sudden increase of luminescence intensity in a threshold-like manner, and a notable spin-polarizability in an externally applied magnetic field. Spatial coherence is mapped out via highly resolved real-space interferometry, revealing a spatially extended condensate. Our device represents a decisive step towards the implementation of coherent light-sources based on atomically thin crystals, as well as non-linear, valleytronic coherent devices.

**链接:** <https://www.nature.com/articles/s41563-021-01000-8>

17. **标题:** Fast crystal growth at ultra-low temperatures  
**作者:** Qiong Gao, Jingdong Ai, Shixiang Tang, Minhuan Li, Yanshuang Chen, Jiping Huang, Hua Tong, Lei Xu, Limei Xu, Hajime Tanaka & Peng Tan  
**摘要:** It is believed that the slow liquid diffusion and geometric frustration brought by a rapid, deep quench inhibit fast crystallization and promote vitrification. Here we report fast crystal growth in charged colloidal systems under deep supercooling, where liquid diffusion is extremely low. By combining experiments and simulations, we show that this process occurs via wall-induced barrierless ordering consisting of two coupled steps: the step-like advancement of



the rough interface that disintegrates frustration, followed by defect repairing inside the newly formed solid phase. The former is a diffusionless collective process, whereas the latter controls crystal quality. We further show that the intrinsic mechanical instability of a disordered glassy state subject to the crystal growth front allows for domino-like fast crystal growth even at ultra-low temperatures. These findings contribute to a deeper understanding of fast crystal growth and may be useful for applications related to vitrification prevention and crystal-quality control.

链接: <https://www.nature.com/articles/s41563-021-00993-6>

18. 标题: Solid-state rigid-rod polymer composite electrolytes with nanocrystalline lithium ion pathways

作者: Ying Wang, Curt J. Zanelotti, Xiaoen Wang, Robert Kerr, Liyu Jin, Wang Hay Kan, Theo J. Dingemans, Maria Forsyth & Louis A. Madsen

摘要: A critical challenge for next-generation lithium-based batteries lies in development of electrolytes that enable thermal safety along with the use of high-energy-density electrodes. We describe molecular ionic composite electrolytes based on an aligned liquid crystalline polymer combined with ionic liquids and concentrated Li salt. This high strength (200 MPa) and non-flammable solid electrolyte possesses outstanding Li<sup>+</sup> conductivity (1 mS cm<sup>-1</sup> at 25 °C) and electrochemical stability (5.6 V versus Li|Li<sup>+</sup>) while suppressing dendrite growth and exhibiting low interfacial resistance (32 Ω cm<sup>2</sup>) and overpotentials (≤120 mV at 1 mA cm<sup>-2</sup>) during Li symmetric cell cycling. A heterogeneous salt doping process modifies a locally ordered polymer-ion assembly to incorporate an inter-grain network filled with defective LiFSI and LiBF<sub>4</sub> nanocrystals, strongly enhancing Li<sup>+</sup> conduction. This modular material fabrication platform shows promise for safe and high-energy-density energy storage and conversion applications, incorporating the fast transport of ceramic-like conductors with the superior flexibility of polymer electrolytes.

链接: <https://www.nature.com/articles/s41563-021-00995-4>

19. 标题: Elastohydrodynamic friction of robotic and human fingers on soft micropatterned substrates

作者: Yunhu Peng, Christopher M. Serfass, Anzu Kawazoe, Yitian Shao, Kenneth Gutierrez, Catherine N. Hill, Veronica J. Santos, Yon Visell & Lilian C. Hsiao

摘要: Frictional sliding between patterned surfaces is of fundamental and practical importance in the haptic engineering of soft materials. In emerging applications such as remote surgery and soft robotics, thin fluid films between solid surfaces lead to a multiphysics coupling between solid deformation and fluid dissipation. Here, we report a scaling law that governs the peak friction values of elastohydrodynamic lubrication on patterned surfaces. These peaks, absent in smooth tribopairs, arise due to a separation of length scales in the lubricant flow. The framework is generated by varying the geometry, elasticity and fluid properties of soft tribopairs and measuring the lubricated friction with a triborheometer. The model correctly predicts the elastohydrodynamic lubrication friction of a bioinspired robotic fingertip and human fingers. Its broad applicability can inform the future design of robotic hands or grippers in realistic conditions, and open up new ways of encoding friction into haptic signals.

链接: <https://www.nature.com/articles/s41563-021-00990-9>



20. 标题: Minimizing hydrogen vacancies to enable highly efficient hybrid perovskites

作者: Xie Zhang, Jimmy-Xuan Shen, Mark E. Turiansky & Chris G. Van de Walle

摘要: Defect-induced non-radiative losses are currently limiting the performance of hybrid perovskite devices. Experimental reports have indicated the existence of point defects that act as detrimental non-radiative recombination centres under iodine-poor synthesis conditions. However, the microscopic nature of these defects is still unknown. Here we demonstrate that hydrogen vacancies can be present in high densities under iodine-poor conditions in the prototypical hybrid perovskite MAPbI<sub>3</sub> (MA = CH<sub>3</sub>NH<sub>3</sub>). They act as very efficient non-radiative recombination centres with an exceptionally high carrier capture coefficient of 10<sup>-4</sup> cm<sup>3</sup> s<sup>-1</sup>. By contrast, the hydrogen vacancies in FAPbI<sub>3</sub> [FA = CH(NH<sub>2</sub>)<sub>2</sub>] are much more difficult to form and have a capture coefficient that is three orders of magnitude lower. Our study unveils the critical but overlooked role of hydrogen vacancies in hybrid perovskites and rationalizes why FA is essential for realizing high efficiency in hybrid perovskite solar cells. Minimizing the incorporation of hydrogen vacancies is key to enabling the best performance of hybrid perovskites.

链接: <https://www.nature.com/articles/s41563-021-00986-5>



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## *IEL Top25*

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(来源: <http://ieeexplore.ieee.org/>)

**1. 标题:** PiiGAN: Generative Adversarial Networks for Pluralistic Image Inpainting

**出处:** IEEE Access

**作者:** Weiwei Cai; Zhanguo Wei

**摘要:** The latest methods based on deep learning have achieved amazing results regarding the complex work of inpainting large missing areas in an image. But this type of method generally attempts to generate one single “optimal” result, ignoring many other plausible results. Considering the uncertainty of the inpainting task, one sole result can hardly be regarded as a desired regeneration of the missing area. In view of this weakness, which is related to the design of the previous algorithms, we propose a novel deep generative model equipped with a brand new style extractor which can extract the style feature (latent vector) from the ground truth. Once obtained, the extracted style feature and the ground truth are both input into the generator. We also craft a consistency loss that guides the generated image to approximate the ground truth. After iterations, our generator is able to learn the mapping of styles corresponding to multiple sets of vectors. The proposed model can generate a large number of results consistent with the context semantics of the image. Moreover, we evaluated the effectiveness of our model on three datasets, i.e., CelebA, PlantVillage, and MauFlex. Compared to state-of-the-art inpainting methods, this model is able to offer desirable inpainting results with both better quality and higher diversity. The code and model will be made available on <https://github.com/vivitsai/PiiGAN>.

**链接:** <https://ieeexplore.ieee.org/document/9027849>

**2. 标题:** The Impact of COVID-19 on Consumers: Preparing for Digital Sales

**出处:** IEEE Engineering Management Review

**作者:** Rae Yule Kim

**摘要:** COVID-19 has affected everyone's daily lives. At least 316 million people in 42 states have been asked to stay at home to slow down the pandemic. In this aspect, businesses have been susceptible to make substantial transformations. Workplace operations of many businesses went virtual. The effect of the digital transformation on productivity and corporate culture has been studied extensively. Meanwhile, how COVID-19 has influenced consumers and the consumption culture has received relatively limited attention. Managers often take a wait-and-see approach on the impact of COVID-19 on sales. It is often uncertain whether and how many customers will return after the pandemic passes. Consumers live through the pandemic, and some changes might be long-lasting even after the situation eases. We examine the pandemic as an accelerator of the structural change in consumption and the digital transformation in the marketplace. Managers might adapt to the digital transformation in the market to recover or even grow further the sales after COVID-19.

链接: <https://ieeexplore.ieee.org/document/9076858>

3. 标题: A Comprehensive Review of the COVID-19 Pandemic and the Role of IoT, Drones, AI, Blockchain, and 5G in Managing its Impact

出处: IEEE Access

作者: Vinay Chamola; Vikas Hassija; Vatsal Gupta; Mohsen Guizani

摘要: The unprecedented outbreak of the 2019 novel coronavirus, termed as COVID-19 by the World Health Organization (WHO), has placed numerous governments around the world in a precarious position. The impact of the COVID-19 outbreak, earlier witnessed by the citizens of China alone, has now become a matter of grave concern for virtually every country in the world. The scarcity of resources to endure the COVID-19 outbreak combined with the fear of overburdened healthcare systems has forced a majority of these countries into a state of partial or complete lockdown. The number of laboratory-confirmed coronavirus cases has been increasing at an alarming rate throughout the world, with reportedly more than 3 million confirmed cases as of 30 April 2020. Adding to these woes, numerous false reports, misinformation, and unsolicited fears in regards to coronavirus, are being circulated regularly since the outbreak of the COVID-19. In response to such acts, we draw on various reliable sources to present a detailed review of all the major aspects associated with the COVID-19 pandemic. In addition to the direct health implications associated with the outbreak of COVID-19, this study highlights its impact on the global economy. In drawing things to a close, we explore the use of technologies such as the Internet of Things (IoT), Unmanned Aerial Vehicles (UAVs), blockchain, Artificial Intelligence (AI), and 5G, among others, to help mitigate the impact of COVID-19 outbreak.

链接: <https://ieeexplore.ieee.org/document/9086010>

4. 标题: Peeking Inside the Black-Box: A Survey on Explainable Artificial Intelligence (XAI)

出处: IEEE Access

作者: Amina Adadi; Mohammed Berrada

摘要: At the dawn of the fourth industrial revolution, we are witnessing a fast and widespread adoption of artificial intelligence (AI) in our daily life, which contributes to accelerating the shift towards a more algorithmic society. However, even with such unprecedented advancements, a key impediment to the use of AI-based systems is that they often lack transparency. Indeed, the black-box nature of these systems allows powerful predictions, but it cannot be directly explained. This issue has triggered a new debate on explainable AI (XAI). A research field holds substantial promise for improving trust and transparency of AI-based systems. It is recognized as the sine qua non for AI to continue making steady progress without disruption. This survey provides an entry point for interested researchers and practitioners to learn key aspects of the young and rapidly growing body of research related to XAI. Through the lens of the literature, we review the existing approaches regarding the topic, discuss trends surrounding its sphere, and present major research trajectories.

链接: <https://ieeexplore.ieee.org/document/8466590>



5. **标题:** SegNet: A Deep Convolutional Encoder-Decoder Architecture for Image Segmentation

**出处:** IEEE Transactions on Pattern Analysis and Machine Intelligence

**作者:** Vijay Badrinarayanan; Alex Kendall; Roberto Cipolla

**摘要:** We present a novel and practical deep fully convolutional neural network architecture for semantic pixel-wise segmentation termed SegNet. This core trainable segmentation engine consists of an encoder network, a corresponding decoder network followed by a pixel-wise classification layer. The architecture of the encoder network is topologically identical to the 13 convolutional layers in the VGG16 network [1]. The role of the decoder network is to map the low resolution encoder feature maps to full input resolution feature maps for pixel-wise classification. The novelty of SegNet lies in the manner in which the decoder upsamples its lower resolution input feature map(s). Specifically, the decoder uses pooling indices computed in the max-pooling step of the corresponding encoder to perform non-linear upsampling. This eliminates the need for learning to upsample. The upsampled maps are sparse and are then convolved with trainable filters to produce dense feature maps. We compare our proposed architecture with the widely adopted FCN [2] and also with the well known DeepLab-LargeFOV [3], DeconvNet [4] architectures. This comparison reveals the memory versus accuracy trade-off involved in achieving good segmentation performance. SegNet was primarily motivated by scene understanding applications. Hence, it is designed to be efficient both in terms of memory and computational time during inference. It is also significantly smaller in the number of trainable parameters than other competing architectures and can be trained end-to-end using stochastic gradient descent. We also performed a controlled benchmark of SegNet and other architectures on both road scenes and SUN RGB-D indoor scene segmentation tasks. These quantitative assessments show that SegNet provides good performance with competitive inference time and most efficient inference memory-wise as compared to other architectures.

**链接:** <https://ieeexplore.ieee.org/document/7803544>

6. **标题:** Internet of Things for Smart Cities

**出处:** IEEE Internet of Things Journal

**作者:** Andrea Zanella; Nicola Bui; Angelo Castellani; Lorenzo Vangelista; Michele Zorzi

**摘要:** The Internet of Things (IoT) shall be able to incorporate transparently and seamlessly a large number of different and heterogeneous end systems, while providing open access to selected subsets of data for the development of a plethora of digital services. Building a general architecture for the IoT is hence a very complex task, mainly because of the extremely large variety of devices, link layer technologies, and services that may be involved in such a system. In this paper, we focus specifically to an urban IoT system that, while still being quite a broad category, are characterized by their specific application domain. Urban IoTs, in fact, are designed to support the Smart City vision, which aims at exploiting the most advanced communication technologies to support added-value services for the administration of the city and for the citizens. This paper hence provides a comprehensive survey of the enabling technologies, protocols, and architecture for an urban IoT. Furthermore, the paper will present and discuss the technical solutions and best-practice guidelines adopted in the Padova Smart City project, a proof-of-concept deployment of an IoT island in the city of Padova, Italy, performed in collaboration with the city municipality

链接: <https://ieeexplore.ieee.org/document/6740844>

7. 标题: Internet-of-Things (IoT)-Based Smart Agriculture: Toward Making the Fields Talk

出处: IEEE Access

作者: Muhammad Ayaz; Mohammad Ammad-Uddin; Zubair Sharif; Ali Mansour; El-Hadi M. Aggoune

摘要: Despite the perception people may have regarding the agricultural process, the reality is that today's agriculture industry is data-centered, precise, and smarter than ever. The rapid emergence of the Internet-of-Things (IoT) based technologies redesigned almost every industry including "smart agriculture" which moved the industry from statistical to quantitative approaches. Such revolutionary changes are shaking the existing agriculture methods and creating new opportunities along a range of challenges. This article highlights the potential of wireless sensors and IoT in agriculture, as well as the challenges expected to be faced when integrating this technology with the traditional farming practices. IoT devices and communication techniques associated with wireless sensors encountered in agriculture applications are analyzed in detail. What sensors are available for specific agriculture application, like soil preparation, crop status, irrigation, insect and pest detection are listed. How this technology helping the growers throughout the crop stages, from sowing until harvesting, packing and transportation is explained. Furthermore, the use of unmanned aerial vehicles for crop surveillance and other favorable applications such as optimizing crop yield is considered in this article. State-of-the-art IoT-based architectures and platforms used in agriculture are also highlighted wherever suitable. Finally, based on this thorough review, we identify current and future trends of IoT in agriculture and highlight potential research challenges.

链接: <https://ieeexplore.ieee.org/document/8784034>

8. 标题: Toward Causal Representation Learning

出处: IEEE

作者: Bernhard Schölkopf; Francesco Locatello; Stefan Bauer; Nan Rosemary Ke; Nal Kalchbrenner;

摘要: The two fields of machine learning and graphical causality arose and are developed separately. However, there is, now, cross-pollination and increasing interest in both fields to benefit from the advances of the other. In this article, we review fundamental concepts of causal inference and relate them to crucial open problems of machine learning, including transfer and generalization, thereby assaying how causality can contribute to modern machine learning research. This also applies in the opposite direction: we note that most work in causality starts from the premise that the causal variables are given. A central problem for AI and causality is, thus, causal representation learning, that is, the discovery of high-level causal variables from low-level observations. Finally, we delineate some implications of causality for machine learning and propose key research areas at the intersection of both communities.

链接: <https://ieeexplore.ieee.org/document/9363924>

9. 标题: Advancing Neuromorphic Computing With Loihi: A Survey of Results and Outlook

出处: IEEE

作者: Mike Davies; Andreas Wild; Garrick Orchard; Yulia Sandamirskaya; Gabriel A. Fonseca



Guerra

**摘要:** Deep artificial neural networks apply principles of the brain's information processing that led to breakthroughs in machine learning spanning many problem domains. Neuromorphic computing aims to take this a step further to chips more directly inspired by the form and function of biological neural circuits, so they can process new knowledge, adapt, behave, and learn in real time at low power levels. Despite several decades of research, until recently, very few published results have shown that today's neuromorphic chips can demonstrate quantitative computational value. This is now changing with the advent of Intel's Loihi, a neuromorphic research processor designed to support a broad range of spiking neural networks with sufficient scale, performance, and features to deliver competitive results compared to state-of-the-art contemporary computing architectures. This survey reviews results that are obtained to date with Loihi across the major algorithmic domains under study, including deep learning approaches and novel approaches that aim to more directly harness the key features of spike-based neuromorphic hardware. While conventional feedforward deep neural networks show modest if any benefit on Loihi, more brain-inspired networks using recurrence, precise spike-timing relationships, synaptic plasticity, stochasticity, and sparsity perform certain computation with orders of magnitude lower latency and energy compared to state-of-the-art conventional approaches. These compelling neuromorphic networks solve a diverse range of problems representative of brain-like computation, such as event-based data processing, adaptive control, constrained optimization, sparse feature regression, and graph search.

**链接:** <https://ieeexplore.ieee.org/document/9395703>

10. **标题:** A Comprehensive Survey on Graph Neural Networks

**出处:** IEEE

**作者:** Zonghan Wu; Shirui Pan; Fengwen Chen; Guodong Long; Chengqi Zhang;

**摘要:** Deep learning has revolutionized many machine learning tasks in recent years, ranging from image classification and video processing to speech recognition and natural language understanding. The data in these tasks are typically represented in the Euclidean space. However, there is an increasing number of applications, where data are generated from non-Euclidean domains and are represented as graphs with complex relationships and interdependency between objects. The complexity of graph data has imposed significant challenges on the existing machine learning algorithms. Recently, many studies on extending deep learning approaches for graph data have emerged. In this article, we provide a comprehensive overview of graph neural networks (GNNs) in data mining and machine learning fields. We propose a new taxonomy to divide the state-of-the-art GNNs into four categories, namely, recurrent GNNs, convolutional GNNs, graph autoencoders, and spatial-temporal GNNs. We further discuss the applications of GNNs across various domains and summarize the open-source codes, benchmark data sets, and model evaluation of GNNs. Finally, we propose potential research directions in this rapidly growing field.

**链接:** <https://ieeexplore.ieee.org/document/9046288>



11. **标题:** Artificial Intelligence and COVID-19: Deep Learning Approaches for Diagnosis and Treatment

**出处:** IEEE

**作者:** Mohammad Jamshidi; Ali Lalbakhsh; Jakub Talla; Zdeněk Peroutka; Farimah Hadjilooei;

**摘要:** COVID-19 outbreak has put the whole world in an unprecedented difficult situation bringing life around the world to a frightening halt and claiming thousands of lives. Due to COVID-19's spread in 212 countries and territories and increasing numbers of infected cases and death tolls mounting to 5,212,172 and 334,915 (as of May 22 2020), it remains a real threat to the public health system. This paper renders a response to combat the virus through Artificial Intelligence (AI). Some Deep Learning (DL) methods have been illustrated to reach this goal, including Generative Adversarial Networks (GANs), Extreme Learning Machine (ELM), and Long/Short Term Memory (LSTM). It delineates an integrated bioinformatics approach in which different aspects of information from a continuum of structured and unstructured data sources are put together to form the user-friendly platforms for physicians and researchers. The main advantage of these AI-based platforms is to accelerate the process of diagnosis and treatment of the COVID-19 disease. The most recent related publications and medical reports were investigated with the purpose of choosing inputs and targets of the network that could facilitate reaching a reliable Artificial Neural Network-based tool for challenges associated with COVID-19. Furthermore, there are some specific inputs for each platform, including various forms of the data, such as clinical data and medical imaging which can improve the performance of the introduced approaches toward the best responses in practical applications.

**链接:** <https://ieeexplore.ieee.org/document/9115663>

12. **标题:** A Review of Physics Simulators for Robotic Applications

**出处:** IEEE

**作者:** Jack Collins; Shelvin Chand; Anthony Vanderkop; David Howard

**摘要:** The use of simulators in robotics research is widespread, underpinning the majority of recent advances in the field. There are now more options available to researchers than ever before, however navigating through the plethora of choices in search of the right simulator is often non-trivial. Depending on the field of research and the scenario to be simulated there will often be a range of suitable physics simulators from which it is difficult to ascertain the most relevant one. We have compiled a broad review of physics simulators for use within the major fields of robotics research. More specifically, we navigate through key sub-domains and discuss the features, benefits, applications and use-cases of the different simulators categorised by the respective research communities. Our review provides an extensive index of the leading physics simulators applicable to robotics researchers and aims to assist them in choosing the best simulator for their use case.

**链接:** <https://ieeexplore.ieee.org/document/9386154>

13. **标题:** A Survey on Transfer Learning

**出处:** IEEE Transactions on Knowledge and Data Engineering

**作者:** Sinno Jialin Pan; Qiang Yang

**摘要:** A major assumption in many machine learning and data mining algorithms is that the

training and future data must be in the same feature space and have the same distribution. However, in many real-world applications, this assumption may not hold. For example, we sometimes have a classification task in one domain of interest, but we only have sufficient training data in another domain of interest, where the latter data may be in a different feature space or follow a different data distribution. In such cases, knowledge transfer, if done successfully, would greatly improve the performance of learning by avoiding much expensive data-labeling efforts. In recent years, transfer learning has emerged as a new learning framework to address this problem. This survey focuses on categorizing and reviewing the current progress on transfer learning for classification, regression, and clustering problems. In this survey, we discuss the relationship between transfer learning and other related machine learning techniques such as domain adaptation, multitask learning and sample selection bias, as well as covariate shift. We also explore some potential future issues in transfer learning research.

链接: <https://ieeexplore.ieee.org/document/5288526>

14. 标题: Modulation and Multiple Access for 5G Networks

出处: IEEE Communications Surveys & Tutorials

作者: Yunlong Cai; Zhijin Qin; Fangyu Cui; Geoffrey Ye Li; Julie A. McCann

摘要: Fifth generation (5G) wireless networks face various challenges in order to support large-scale heterogeneous traffic and users, therefore new modulation and multiple access (MA) schemes are being developed to meet the changing demands. As this research space is ever increasing, it becomes more important to analyze the various approaches, therefore, in this paper we present a comprehensive overview of the most promising modulation and MA schemes for 5G networks. Unlike other surveys of 5G networks, this paper focuses on multiplexing techniques, including modulation techniques in orthogonal MA (OMA) and various types of non-OMA (NOMA) techniques. Specifically, we first introduce different types of modulation schemes, potential for OMA, and compare their performance in terms of spectral efficiency, out-of-band leakage, and bit-error rate. We then pay close attention to various types of NOMA candidates, including power-domain NOMA, code-domain NOMA, and NOMA multiplexing in multiple domains. From this exploration, we can identify the opportunities and challenges that will have the most significant impacts on modulation and MA designs for 5G networks.

链接: <https://ieeexplore.ieee.org/document/8085125>

15. 标题: COVID-19 Artificial Intelligence Diagnosis Using Only Cough Recordings

出处: IEEE Open Journal of Engineering in Medicine and Biology

作者: Jordi Laguarda; Ferran Hueto; Brian Subirana

摘要: Goal: We hypothesized that COVID-19 subjects, especially including asymptomatics, could be accurately discriminated only from a forced-cough cell phone recording using Artificial Intelligence. To train our MIT Open Voice model we built a data collection pipeline of COVID-19 cough recordings through our website ([opensigma.mit.edu](https://opensigma.mit.edu)) between April and May 2020 and created the largest audio COVID-19 cough balanced dataset reported to date with 5,320 subjects. Methods: We developed an AI speech processing framework that leverages acoustic biomarker feature extractors to pre-screen for COVID-19 from cough recordings, and provide a personalized patient saliency map to longitudinally monitor patients in real-time, non-invasively, and at

essentially zero variable cost. Cough recordings are transformed with Mel Frequency Cepstral Coefficient and inputted into a Convolutional Neural Network (CNN) based architecture made up of one Poisson biomarker layer and 3 pre-trained ResNet50's in parallel, outputting a binary pre-screening diagnostic. Our CNN-based models have been trained on 4256 subjects and tested on the remaining 1064 subjects of our dataset. Transfer learning was used to learn biomarker features on larger datasets, previously successfully tested in our Lab on Alzheimer's, which significantly improves the COVID-19 discrimination accuracy of our architecture. Results: When validated with subjects diagnosed using an official test, the model achieves COVID-19 sensitivity of 98.5% with a specificity of 94.2% (AUC: 0.97). For asymptomatic subjects it achieves sensitivity of 100% with a specificity of 83.2%. Conclusions: AI techniques can produce a free, non-invasive, real-time, any-time, instantly distributable, large-scale COVID-19 asymptomatic screening tool to augment current approaches in containing the spread of COVID-19. Practical use cases could be for daily screening of students, workers, and public as schools, jobs, and transport reopen, or for pool testing to quickly alert of outbreaks in groups. General speech biomarkers may exist that cover several disease categories, as we demonstrated using the same ones for COVID-19 and Alzheimer's.

链接: <https://ieeexplore.ieee.org/document/9208795>

16. 标题: A Survey of 5G Network: Architecture and Emerging Technologies

出处: IEEE Access

作者: A. Gupta; R. K. Jha

摘要: In the near future, i.e., beyond 4G, some of the prime objectives or demands that need to be addressed are increased capacity, improved data rate, decreased latency, and better quality of service. To meet these demands, drastic improvements need to be made in cellular network architecture. This paper presents the results of a detailed survey on the fifth generation (5G) cellular network architecture and some of the key emerging technologies that are helpful in improving the architecture and meeting the demands of users. In this detailed survey, the prime focus is on the 5G cellular network architecture, massive multiple input multiple output technology, and device-to-device communication (D2D). Along with this, some of the emerging technologies that are addressed in this paper include interference management, spectrum sharing with cognitive radio, ultra-dense networks, multi-radio access technology association, full duplex radios, millimeter wave solutions for 5G cellular networks, and cloud technologies for 5G radio access networks and software defined networks. In this paper, a general probable 5G cellular network architecture is proposed, which shows that D2D, small cell access points, network cloud, and the Internet of Things can be a part of 5G cellular network architecture. A detailed survey is included regarding current research projects being conducted in different countries by research groups and institutions that are working on 5G technologies.

链接: <https://ieeexplore.ieee.org/document/7169508>

17. 标题: VINS-Mono: A Robust and Versatile Monocular Visual-Inertial State Estimator

出处: IEEE Transactions on Robotics

作者: Tong Qin; Peiliang Li; Shaojie Shen

摘要: One camera and one low-cost inertial measurement unit (IMU) form a monocular

visual-inertial system (VINS), which is the minimum sensor suite (in size, weight, and power) for the metric six degrees-of-freedom (DOF) state estimation. In this paper, we present VINS-Mono: a robust and versatile monocular visual-inertial state estimator. Our approach starts with a robust procedure for estimator initialization. A tightly coupled, nonlinear optimization-based method is used to obtain highly accurate visual-inertial odometry by fusing preintegrated IMU measurements and feature observations. A loop detection module, in combination with our tightly coupled formulation, enables relocalization with minimum computation. We additionally perform 4-DOF pose graph optimization to enforce the global consistency. Furthermore, the proposed system can reuse a map by saving and loading it in an efficient way. The current and previous maps can be merged together by the global pose graph optimization. We validate the performance of our system on public datasets and real-world experiments and compare against other state-of-the-art algorithms. We also perform an onboard closed-loop autonomous flight on the microaerial-vehicle platform and port the algorithm to an iOS-based demonstration. We highlight that the proposed work is a reliable, complete, and versatile system that is applicable for different applications that require high accuracy in localization.

链接: <https://ieeexplore.ieee.org/document/8421746>

18. 标题: Explaining Deep Neural Networks and Beyond: A Review of Methods and Applications

出处: Proceedings of the IEEE

作者: Wojciech Samek; Grégoire Montavon; Sebastian Lapuschkin; Christopher J. Anders; Klaus-Robert Müller

摘要: With the broader and highly successful usage of machine learning (ML) in industry and the sciences, there has been a growing demand for explainable artificial intelligence (XAI). Interpretability and explanation methods for gaining a better understanding of the problem-solving abilities and strategies of nonlinear ML, in particular, deep neural networks, are, therefore, receiving increased attention. In this work, we aim to: 1) provide a timely overview of this active emerging field, with a focus on “post hoc” explanations, and explain its theoretical foundations; 2) put interpretability algorithms to a test both from a theory and comparative evaluation perspective using extensive simulations; 3) outline best practice aspects, i.e., how to best include interpretation methods into the standard usage of ML; and 4) demonstrate successful usage of XAI in a representative selection of application scenarios. Finally, we discuss challenges and possible future directions of this exciting foundational field of ML.

链接: <https://ieeexplore.ieee.org/document/9369420>

19. 标题: Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks

出处: IEEE Transactions on Pattern Analysis and Machine Intelligence

作者: Shaoqing Ren; Kaiming He; Ross Girshick; Jian Sun

摘要: State-of-the-art object detection networks depend on region proposal algorithms to hypothesize object locations. Advances like SPPnet [1] and Fast R-CNN [2] have reduced the running time of these detection networks, exposing region proposal computation as a bottleneck. In this work, we introduce a Region Proposal Network(RPN) that shares full-image convolutional features with the detection network, thus enabling nearly cost-free region proposals. An RPN is a



fully convolutional network that simultaneously predicts object bounds and objectness scores at each position. The RPN is trained end-to-end to generate high-quality region proposals, which are used by Fast R-CNN for detection. We further merge RPN and Fast R-CNN into a single network by sharing their convolutional features-using the recently popular terminology of neural networks with 'attention' mechanisms, the RPN component tells the unified network where to look. For the very deep VGG-16 model [3], our detection system has a frame rate of 5 fps (including all steps) on a GPU, while achieving state-of-the-art object detection accuracy on PASCAL VOC 2007, 2012, and MS COCO datasets with only 300 proposals per image. In ILSVRC and COCO 2015 competitions, Faster R-CNN and RPN are the foundations of the 1st-place winning entries in several tracks. Code has been made publicly available.

链接: <https://ieeexplore.ieee.org/document/7485869>

20. 标题: Blockchains and Smart Contracts for the Internet of Things

出处: IEEE Access

作者: Konstantinos Christidis; Michael Devetsikiotis

摘要: Motivated by the recent explosion of interest around blockchains, we examine whether they make a good fit for the Internet of Things (IoT) sector. Blockchains allow us to have a distributed peer-to-peer network where non-trusting members can interact with each other without a trusted intermediary, in a verifiable manner. We review how this mechanism works and also look into smart contracts-scripts that reside on the blockchain that allow for the automation of multi-step processes. We then move into the IoT domain, and describe how a blockchain-IoT combination: 1) facilitates the sharing of services and resources leading to the creation of a marketplace of services between devices and 2) allows us to automate in a cryptographically verifiable manner several existing, time-consuming workflows. We also point out certain issues that should be considered before the deployment of a blockchain network in an IoT setting: from transactional privacy to the expected value of the digitized assets traded on the network. Wherever applicable, we identify solutions and workarounds. Our conclusion is that the blockchain-IoT combination is powerful and can cause significant transformations across several industries, paving the way for new business models and novel, distributed applications.

链接: <https://ieeexplore.ieee.org/document/7467408>

21. 标题: A Unifying Review of Deep and Shallow Anomaly Detection

出处: Proceedings of the IEEE

作者: Lukas Ruff; Jacob R. Kauffmann; Robert A. Vandermeulen; Grégoire Montavon; Wojciech Samek;

摘要: Deep learning approaches to anomaly detection (AD) have recently improved the state of the art in detection performance on complex data sets, such as large collections of images or text. These results have sparked a renewed interest in the AD problem and led to the introduction of a great variety of new methods. With the emergence of numerous such methods, including approaches based on generative models, one-class classification, and reconstruction, there is a growing need to bring methods of this field into a systematic and unified perspective. In this review, we aim to identify the common underlying principles and the assumptions that are often made implicitly by various methods. In particular, we draw connections between classic

“shallow” and novel deep approaches and show how this relation might cross-fertilize or extend both directions. We further provide an empirical assessment of major existing methods that are enriched by the use of recent explainability techniques and present specific worked-through examples together with practical advice. Finally, we outline critical open challenges and identify specific paths for future research in AD.

链接: <https://ieeexplore.ieee.org/document/9347460>

22. 标题: Digital Twin: Enabling Technologies, Challenges and Open Research

出处: IEEE Access

作者: Aidan Fuller; Zhong Fan; Charles Day; Chris Barlow

摘要: Digital Twin technology is an emerging concept that has become the centre of attention for industry and, in more recent years, academia. The advancements in industry 4.0 concepts have facilitated its growth, particularly in the manufacturing industry. The Digital Twin is defined extensively but is best described as the effortless integration of data between a physical and virtual machine in either direction. The challenges, applications, and enabling technologies for Artificial Intelligence, Internet of Things (IoT) and Digital Twins are presented. A review of publications relating to Digital Twins is performed, producing a categorical review of recent papers. The review has categorised them by research areas: manufacturing, healthcare and smart cities, discussing a range of papers that reflect these areas and the current state of research. The paper provides an assessment of the enabling technologies, challenges and open research for Digital Twins.

链接: <https://ieeexplore.ieee.org/document/9103025>

23. 标题: A fast and elitist multiobjective genetic algorithm: NSGA-II

出处: IEEE Transactions on Evolutionary Computation

作者: K. Deb; A. Pratap; S. Agarwal; T. Meyarivan

摘要: Multi-objective evolutionary algorithms (MOEAs) that use non-dominated sorting and sharing have been criticized mainly for: (1) their  $O(MN/\sup 3/)$  computational complexity (where  $M$  is the number of objectives and  $N$  is the population size); (2) their non-elitism approach; and (3) the need to specify a sharing parameter. In this paper, we suggest a non-dominated sorting-based MOEA, called NSGA-II (Non-dominated Sorting Genetic Algorithm II), which alleviates all of the above three difficulties. Specifically, a fast non-dominated sorting approach with  $O(MN/\sup 2/)$  computational complexity is presented. Also, a selection operator is presented that creates a mating pool by combining the parent and offspring populations and selecting the best  $N$  solutions (with respect to fitness and spread). Simulation results on difficult test problems show that NSGA-II is able, for most problems, to find a much better spread of solutions and better convergence near the true Pareto-optimal front compared to the Pareto-archived evolution strategy and the strength-Pareto evolutionary algorithm - two other elitist MOEAs that pay special attention to creating a diverse Pareto-optimal front. Moreover, we modify the definition of dominance in order to solve constrained multi-objective problems efficiently. Simulation results of the constrained NSGA-II on a number of test problems, including a five-objective, seven-constraint nonlinear problem, are compared with another constrained multi-objective optimizer, and the much better performance of NSGA-II is observed.

链接: <https://ieeexplore.ieee.org/document/996017>

24. 标题: Artificial Intelligence in Education: A Review

出处: IEEE Access

作者: Lijia Chen; Pingping Chen; Zhijian Lin

摘要: The purpose of this study was to assess the impact of Artificial Intelligence (AI) on education. Premised on a narrative and framework for assessing AI identified from a preliminary analysis, the scope of the study was limited to the application and effects of AI in administration, instruction, and learning. A qualitative research approach, leveraging the use of literature review as a research design and approach was used and effectively facilitated the realization of the study purpose. Artificial intelligence is a field of study and the resulting innovations and developments that have culminated in computers, machines, and other artifacts having human-like intelligence characterized by cognitive abilities, learning, adaptability, and decision-making capabilities. The study ascertained that AI has extensively been adopted and used in education, particularly by education institutions, in different forms. AI initially took the form of computer and computer related technologies, transitioning to web-based and online intelligent education systems, and ultimately with the use of embedded computer systems, together with other technologies, the use of humanoid robots and web-based chatbots to perform instructors' duties and functions independently or with instructors. Using these platforms, instructors have been able to perform different administrative functions, such as reviewing and grading students' assignments more effectively and efficiently, and achieve higher quality in their teaching activities. On the other hand, because the systems leverage machine learning and adaptability, curriculum and content has been customized and personalized in line with students' needs, which has fostered uptake and retention, thereby improving learners experience and overall quality of learning.

链接: <https://ieeexplore.ieee.org/document/9069875>

25. 标题: Internet of Things (IoT) for Next-Generation Smart Systems: A Review of Current Challenges, Future Trends and Prospects for Emerging 5G-IoT Scenarios

出处: IEEE Access

作者: Kinza Shafique; Bilal A. Khawaja; Farah Sabir; Sameer Qazi; Muhammad Mustaqim

摘要: The Internet of Things (IoT)-centric concepts like augmented reality, high-resolution video streaming, self-driven cars, smart environment, e-health care, etc. have a ubiquitous presence now. These applications require higher data-rates, large bandwidth, increased capacity, low latency and high throughput. In light of these emerging concepts, IoT has revolutionized the world by providing seamless connectivity between heterogeneous networks (HetNets). The eventual aim of IoT is to introduce the plug and play technology providing the end-user, ease of operation, remotely access control and configurability. This paper presents the IoT technology from a bird's eye view covering its statistical/architectural trends, use cases, challenges and future prospects. The paper also presents a detailed and extensive overview of the emerging 5G-IoT scenario. Fifth Generation (5G) cellular networks provide key enabling technologies for ubiquitous deployment of the IoT technology. These include carrier aggregation, multiple-input multiple-output (MIMO), massive-MIMO (M-MIMO), coordinated multipoint processing (CoMP), device-to-device (D2D) communications, centralized radio access network (CRAN), software-defined wireless sensor





networking (SD-WSN), network function virtualization (NFV) and cognitive radios (CRs). This paper presents an exhaustive review for these key enabling technologies and also discusses the new emerging use cases of 5G-IoT driven by the advances in artificial intelligence, machine and deep learning, ongoing 5G initiatives, quality of service (QoS) requirements in 5G and its standardization issues. Finally, the paper discusses challenges in the implementation of 5G-IoT due to high data-rates requiring both cloud-based platforms and IoT devices based edge computing.

链接: <https://ieeexplore.ieee.org/document/8972389>

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## *ESI HOT PAPERS*

### *(Materials Science)*

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(来源: <http://esi.incites.thomsonreuters.com>)

1 被引频次: 1307

题目: PHONON COHERENCES REVEAL THE POLARONIC CHARACTER OF EXCITONS IN TWO-DIMENSIONAL LEAD HALIDE PEROVSKITES

作者: THOUIN, F;VALVERDE-CHAVEZ, DA;QUARTI, C;CORTECCHIA, D;BARGIGIA, I;BELJONNE, D;PETROZZA, A;SILVA, C;KANDADA, ARS

出处: NATURE MATERIALS 18 (4): 349-+ APR 2019

摘要: Hybrid organic-inorganic semiconductors feature complex lattice dynamics due to the ionic character of the crystal and the softness arising from non-covalent bonds between molecular moieties and the inorganic network. Here we establish that such dynamic structural complexity in a prototypical two-dimensional lead iodide perovskite gives rise to the coexistence of diverse excitonic resonances, each with a distinct degree of polaronic character. By means of high-resolution resonant impulsive stimulated Raman spectroscopy, we identify vibrational wavepacket dynamics that evolve along different configurational coordinates for distinct excitons and photocarriers. Employing density functional theory calculations, we assign the observed coherent vibrational modes to various low-frequency (less than or similar to 50 cm<sup>-1</sup>) optical phonons involving motion in the lead iodide layers. We thus conclude that different excitons induce specific lattice reorganizations, which are signatures of polaronic binding. This insight into the energetic/configurational landscape involving globally neutral primary photoexcitations may be relevant to a broader class of emerging hybrid semiconductor materials.

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2 被引频次: 350

题目: SINGLE-JUNCTION POLYMER SOLAR CELLS WITH 16.35% EFFICIENCY ENABLED BY A PLATINUM(II) COMPLEXATION STRATEGY

作者: XU, XP;FENG, K;BI, ZZ;MA, W;ZHANG, GJ;PENG, Q

出处: ADVANCED MATERIALS 31 (29): - JUL 2019

摘要: A new strategy of platinum(II) complexation is developed to regulate the crystallinity and molecular packing of polynitrogen heterocyclic polymers, optimize the morphology of the active blends, and improve the efficiency of the resulting nonfullerene polymer solar cells

(NF-PSCs). The newly designed s-tetrazine (s-TZ)-containing copolymer of PSFTZ (4,8-bis(5-((2-butyloctyl)thio)-4-fluorothiophen-2-yl)benzo[1,2-b:4,5-b']dithiophene-alt-3,6-bis(4-octylthiophen-2-yl)-1,2,4,5-tetrazine) has a strong aggregation property, which results in serious phase separation and large domains when blending with Y6 ((2,2'-(2Z,2'Z)-((12,13-bis(2-ethylhexyl)-3,9-diundecyl-12,13-dihydro-[1,2,5]thiadiazolo[3,4-e]thieno[2',3':4',5']thieno[2',3':4,5]pyrrolo[3,2-g]thieno[2',3':4,5]thieno[3,2-b]indole-2,10-diyl)bis(methanylylidene))bis(5,6-difluoro-3-oxo-2,3-dihydro-1H-indene-2,1-diylidene))dimalononitrile)), and produces a power-conversion efficiency (PCE) of 13.03%. By adding small amount of Pt(Ph)(2)(DMSO)(2) (Ph, phenyl and DMSO, dimethyl sulfoxide), platinum(II) complexation would occur between Pt(Ph)(2)(DMSO)(2) and PSFTZ. The bulky benzene ring on the platinum(II) complex increases the steric hindrance along the polymer main chain, inhibits the polymer aggregation strength, regulates the phase separation, optimizes the morphology, and thus improves the efficiency to 16.35% in the resulting devices. 16.35% is the highest efficiency for single-junction PSCs reported so far.

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3 被引频次: 348

题目: OVER 16% EFFICIENCY ORGANIC PHOTOVOLTAIC CELLS ENABLED BY A CHLORINATED ACCEPTOR WITH INCREASED OPEN-CIRCUIT VOLTAGES

作者: CUI, Y;YAO, HF;ZHANG, JQ;ZHANG, T;WANG, YM;HONG, L;XIAN, KH;XU, BW;ZHANG, SQ;PENG, J;WEI, ZX;GAO, F;HOU, JH

出处: NATURE COMMUNICATIONS 10: - JUN 7 2019

摘要: Broadening the optical absorption of organic photovoltaic (OPV) materials by enhancing the intramolecular push-pull effect is a general and effective method to improve the power conversion efficiencies of OPV cells. However, in terms of the electron acceptors, the most common molecular design strategy of halogenation usually results in down-shifted molecular energy levels, thereby leading to decreased open-circuit voltages in the devices. Herein, we report a chlorinated non-fullerene acceptor, which exhibits an extended optical absorption and meanwhile displays a higher voltage than its fluorinated counterpart in the devices. This unexpected phenomenon can be ascribed to the reduced non-radiative energy loss (0.206 eV). Due to the simultaneously improved short-circuit current density and open-circuit voltage, a high efficiency of 16.5% is achieved. This study demonstrates that finely tuning the OPV materials to reduce the bandgap-voltage offset has great potential for boosting the efficiency.

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4 被引频次: 281

题目: NANOARCHITECTONICS FOR TRANSITION-METAL-SULFIDE-BASED ELECTROCATALYSTS FOR WATER SPLITTING

作者: GUO, YN;PARK, T;YI, JW;HENZIE, J;KIM, J;WANG, ZL;JIANG, B;BANDO, Y;SUGAHARA, Y;TANG, J;YAMAUCHI, Y

出处: ADVANCED MATERIALS 31 (17): - APR 25 2019

摘要: Heterogenous electrocatalysts based on transition metal sulfides (TMS) are being actively explored in renewable energy research because nanostructured forms support high intrinsic activities for both the hydrogen evolution reaction (HER) and oxygen evolution reaction (OER). Herein, it is described how researchers are working to improve the performance of TMS-based materials by manipulating their internal and external nanoarchitectures. A general introduction to the water-splitting reaction is initially provided to explain the most important parameters in accessing the catalytic performance of nanomaterials catalysts. Later, the general synthetic methods used to prepare TMS-based materials are explained in order to delve into the various strategies being used to achieve higher electrocatalytic performance in the HER. Complementary strategies can be used to increase the OER performance of TMS, resulting in bifunctional water-splitting electrocatalysts for both the HER and the OER. Finally, the current challenges and future opportunities of TMS materials in the context of water splitting are summarized. The aim herein is to provide insights gathered in the process of studying TMS, and describe valuable guidelines for engineering other kinds of nanomaterial catalysts for energy conversion and storage technologies.

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5 被引频次: 279

题目: THERMODYNAMICALLY STABILIZED BETA-CSPBI3-BASED PEROVSKITE SOLAR CELLS WITH EFFICIENCIES > 18%

作者: WANG, Y;DAR, MI;ONO, LK;ZHANG, TY;KAN, M;LI, YW;ZHANG, LJ;WANG, XT;YANG, YG;GAO, XY;QI, YB;GRATZEL, M;ZHAO, YX

出处: SCIENCE 365 (6453): 591-+ AUG 9 2019

摘要: Although beta-CsPbI3 has a bandgap favorable for application in tandem solar cells,

depositing and stabilizing beta-CsPbI<sub>3</sub> experimentally has remained a challenge. We obtained highly crystalline beta-CsPbI<sub>3</sub> films with an extended spectral response and enhanced phase stability. Synchrotron-based x-ray scattering revealed the presence of highly oriented beta-CsPbI<sub>3</sub> grains, and sensitive elemental analyses-including inductively coupled plasma mass spectrometry and time-of-flight secondary ion mass spectrometry-confirmed their all-inorganic composition. We further mitigated the effects of cracks and pinholes in the perovskite layer by surface treating with choline iodide, which increased the charge-carrier lifetime and improved the energy-level alignment between the beta-CsPbI<sub>3</sub> absorber layer and carrier-selective contacts. The perovskite solar cells made from the treated material have highly reproducible and stable efficiencies reaching 18.4% under 45 +/- 5 degrees C ambient conditions.

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6 被引频次: 275

题目: A REVIEW OF PEROVSKITES SOLAR CELL STABILITY

作者: WANG, R;MUJAHID, M;DUAN, Y;WANG, ZK;XUE, JJ;YANG, Y

出处: ADVANCED FUNCTIONAL MATERIALS 29 (47): - SP. ISS. SI NOV 2019

摘要: In this review, the factors influencing the power conversion efficiency (PCE) of perovskite solar cells (PSCs) is emphasized. The PCE of PSCs has remarkably increased from 3.8% to 23.7%, but on the other hand, poor stability is one of the main facets that creates a huge barrier in the commercialization of PSCs. Herein, a concise overview of the current efforts to enhance the stability of PSCs is provided; moreover, the degradation causes and mechanisms are summarized. The strategies to improve device stability are portrayed in terms of structural effects, a photoactive layer, hole- and electron-transporting layers, electrode materials, and device encapsulation. Last but not least, the economic feasibility of PSCs is also vividly discussed.

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7 被引频次: 273

题目: PLANAR PEROVSKITE SOLAR CELLS WITH LONG-TERM STABILITY USING IONIC LIQUID ADDITIVES

作者: BAI, S;DA, PM;LI, C;WANG, ZP;YUAN, ZC;FU, F;KAWECKI, M;LIU, XJ;SAKAI, N;WANG, JTW;HUETTNER, S;BUECHELER, S;FAHLMAN, M;GAO, F;SNAITH, HJ

出处: NATURE 571 (7764): 245-+ JUL 11 2019

摘要: Solar cells based on metal halide perovskites are one of the most promising photovoltaic technologies(1-4). Over the past few years, the long-term operational stability of such devices has been greatly improved by tuning the composition of the perovskites(5-9), optimizing the interfaces within the device structures(10-13), and using new encapsulation techniques(14,15). However, further improvements are required in order to deliver a longer-lasting technology. Ion migration in the perovskite active layer-especially under illumination and heat-is arguably the most difficult aspect to mitigate(16-18). Here we incorporate ionic liquids into the perovskite film and thence into positive-intrinsic-negative photovoltaic devices, increasing the device efficiency and markedly improving the long-term device stability. Specifically, we observe a degradation in performance of only around five per cent for the most stable encapsulated device under continuous simulated full-spectrum sunlight for more than 1,800 hours at 70 to 75 degrees Celsius, and estimate that the time required for the device to drop to eighty per cent of its peak performance is about 5,200 hours. Our demonstration of long-term operational, stable solar cells under intense conditions is a key step towards a reliable perovskite photovoltaic technology. 地址: UNIV OXFORD, CLARENDON LAB, OXFORD, ENGLAND;LINKOPING UNIV, DEPT PHYS CHEM & BIOL IFM, LINKOPING, SWEDEN;UNIV BAYREUTH, DEPT CHEM, BAYREUTH, GERMANY;EMPA SWISS FED LABS MAT SCI & TECHNOL, LAB THIN FILMS & PHOTOVOLTA, DUBENDORF, SWITZERLAND;EMPA, LAB NANOSCALE MAT SCI, DUBENDORF, SWITZERLAND;UNIV BASEL, DEPT PHYS, BASEL, SWITZERLAND;CSIRO ENERGY, MAYFIELD WEST, NSW, AUSTRALIA;XIAMEN UNIV, SCH ELECT SCI & ENGN, XIAMEN, FUJIAN, PEOPLES R CHINA

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8 被引频次: 272

题目: PRESENT AND FUTURE OF SURFACE-ENHANCED RAMAN SCATTERING

作者: LANGER, J;DE ABERASTURI, DJ;AIZPURUA, J;ALVAREZ-PUEBLA, RA;AUGUIE, B;BAUMBERG, JJ;BAZAN, GC;BELL, SEJ;BOISEN, A;BROLO, AG;CHOO, J;CIALLA-MAY, D;DECKERT, V;FABRIS, L;FAULDS, K;DE ABAJO, FIG;GOODACRE, R;GRAHAM, D;HAES, AJ;HAYNES, CL;HUCK, C;ITOH, T;KA, M;KNEIPP, J;KOTOV, NA;KUANG, H;LE RU, EC;LEE, HK;LI, JF;LING, XY;MAIER, SA;MAYERHOFER, T;MOSKOVITS, M;MURAKOSHI, K;NAM, JM;NIE, S;OZAKI, Y;PASTORIZA-SANTOS, I;PEREZ-JUSTE, J;POPP, J;PUCCI, A;REICH, S;REN, B;SCHATZ, GC;SHEGAI, T;SCHLUCKER, S;TAY, LL;THOMAS, KG;TIAN, ZQ;VAN DUYN, RP;VO-DINH, T;WANG, Y;WILLETTS, KA;XU, C;XU, H;XU, Y;YAMAMOTO, YS;ZHAO, B;LIZ-MARZAN, LM

出处: ACS NANO 14 (1): 28-117 JAN 2020

摘要: The discovery of the enhancement of Raman scattering by molecules adsorbed on nanostructured metal surfaces is a landmark in the history of spectroscopic and analytical



techniques. Significant experimental and theoretical effort has been directed toward understanding the surface-enhanced Raman scattering (SERS) effect and demonstrating its potential in various types of ultrasensitive sensing applications in a wide variety of fields. In the 45 years since its discovery, SERS has blossomed into a rich area of research and technology, but additional efforts are still needed before it can be routinely used analytically and in commercial products. In this Review, prominent authors from around the world joined together to summarize the state of the art in understanding and using SERS and to predict what can be expected in the near future in terms of research, applications, and technological development. This Review is dedicated to SERS pioneer and our coauthor, the late Prof. Richard Van Duyne, whom we lost during the preparation of this article.

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9 被引频次: 263

题目: ADVANCES IN MAGNETOELECTRIC MULTIFERROICS

作者: SPALDIN, NA; RAMESH, R





出处: NATURE MATERIALS 18 (3): 203-212 MAR 2019

摘要: The manipulation of magnetic properties by an electric field in magnetoelectric multiferroic materials has driven significant research activity, with the goal of realizing their transformative technological potential. Here, we review progress in the fundamental understanding and design of new multiferroic materials, advances in characterization and modelling tools to describe them, and the exploration of devices and applications. Focusing on the translation of the many scientific breakthroughs into technological innovations, we identify the key open questions in the field where targeted research activities could have maximum impact in transitioning scientific discoveries into real applications.

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10 被引频次: 248

题目: HIGH-ENTROPY ALLOYS

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出处: NATURE REVIEWS MATERIALS 4 (8): 515-534 AUG 2019

摘要: Alloying has long been used to confer desirable properties to materials. Typically, it involves the addition of relatively small amounts of secondary elements to a primary element. For the past decade and a half, however, a new alloying strategy that involves the combination of multiple principal elements in high concentrations to create new materials called high-entropy alloys has been in vogue. The multi-dimensional compositional space that can be tackled with this approach is practically limitless, and only tiny regions have been investigated so far. Nevertheless, a few high-entropy alloys have already been shown to possess exceptional properties, exceeding those of conventional alloys, and other outstanding high-entropy alloys are likely to be discovered in the future. Here, we review recent progress in understanding the salient features of high-entropy alloys. Model alloys whose behaviour has been carefully investigated are highlighted and their fundamental properties and underlying elementary mechanisms discussed. We also address the vast compositional space that remains to be explored and outline fruitful ways to identify regions within this space where high-entropy alloys with potentially interesting properties may be lurking.

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11 被引频次: 242

题目: MAGNETIC 2D MATERIALS AND HETEROSTRUCTURES

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出处: NATURE NANOTECHNOLOGY 14 (5): 408-419 MAY 2019

摘要: The family of two-dimensional (2D) materials grows day by day, hugely expanding the scope of possible phenomena to be explored in two dimensions, as well as the possible van der Waals (vdW) heterostructures that one can create. Such 2D materials currently cover a vast range of properties. Until recently, this family has been missing one crucial member: 2D magnets. The situation has changed over the past 2 years with the introduction of a variety of atomically thin magnetic crystals. Here we will discuss the difference between magnetic states in 2D materials and in bulk crystals and present an overview of the 2D magnets that have been explored recently. We will focus on the case of the two most studied systems-semiconducting CrI<sub>3</sub> and metallic Fe<sub>3</sub>GeTe<sub>2</sub>-and illustrate the physical phenomena that have been observed. Special attention will be given to the range of new van der Waals heterostructures that became possible with the appearance of 2D magnets, offering new perspectives in this rapidly expanding field.

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12 被引频次: 242

题目: APPROACHING HIGH-PERFORMANCE POTASSIUM-ION BATTERIES VIA ADVANCED DESIGN STRATEGIES AND ENGINEERING

作者: ZHANG, WC;LIU, YJ;GUO, ZP

出处: SCIENCE ADVANCES 5 (5): - MAY 2019

摘要: Potassium-ion batteries (PIBs) have attracted tremendous attention due to their low cost, fast ionic conductivity in electrolyte, and high operating voltage. Research on PIBs is still in its infancy, however, and achieving a general understanding of the drawbacks of each component and proposing research strategies for overcoming these problems are crucial for the exploration of suitable electrode materials/electrolytes and the establishment of electrode/cell assembly technologies for further development of PIBs. In this review, we summarize our current understanding in this field, classify and highlight the design strategies for addressing the key issues in the research on PIBs, and propose possible pathways for the future development of PIBs toward practical applications. The strategies and perspectives summarized in this review aim to provide practical guidance for an increasing number of researchers to explore next-generation and high-performance PIBs, and the methodology may also be applicable to developing other energy storage systems.

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13 被引频次: 234

题目: SOLAR CELLS CARRIER LIFETIMES OF  $> 1 \mu\text{s}$  IN SN-PB PEROVSKITES ENABLE EFFICIENT ALL-PEROVSKITE TANDEM SOLAR CELLS

作者: TONG, JH; SONG, ZN; KIM, DH; CHEN, XH; CHEN, C; PALMSTROM, AF; NDIONE, PF; REESE, MO; DUNFIELD, SP; REID, OG; LIU, J; ZHANG, F; HARVEY, SP; LI, Z; CHRISTENSEN, ST; TEETER, G; ZHAO, DW; AL-JASSIM, MM; VAN HEST, MFAM; BEARD, MC; SHAHEEN, SE; BERRY, JJ; YAN, YF; ZHU, K 出处: SCIENCE 364 (6439): 475-+ MAY 3 2019

摘要: All-perovskite-based polycrystalline thin-film tandem solar cells have the potential to deliver efficiencies of  $>30\%$ . However, the performance of all-perovskite-based tandem devices has been limited by the lack of high-efficiency, low-band gap tin-lead (Sn-Pb) mixed-perovskite solar cells (PSCs). We found that the addition of guanidinium thiocyanate (GuaSCN) resulted in marked improvements in the structural and optoelectronic properties of Sn-Pb mixed, low-band gap (similar to 1.25 electron volt) perovskite films. The films have defect densities that are lower by a factor of 10, leading to carrier lifetimes of greater than 1 microsecond and diffusion lengths of 2.5 micrometers. These improved properties enable our demonstration of  $>20\%$  efficient low-band gap PSCs. When combined with wider-band gap PSCs, we achieve 25% efficient four-terminal and 23.1% efficient two-terminal all-perovskite-based polycrystalline thin-film tandem solar cells.

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14 被引频次: 234

题目: SINGLE-JUNCTION ORGANIC PHOTOVOLTAIC CELLS WITH APPROACHING 18% EFFICIENCY 作者: CUI, Y; YAO, HF; ZHANG, JQ; XIAN, KH; ZHANG, T; HONG, L; WANG, YM; XU, Y; MA, KQ; AN, CB; HE, C; WEI, ZX; GAO, F; HOU, JH

出处: ADVANCED MATERIALS 32 (19): - MAY 2020

摘要: Optimizing the molecular structures of organic photovoltaic (OPV) materials is one of the most effective methods to boost power conversion efficiencies (PCEs). For an excellent molecular system with a certain conjugated skeleton, fine tuning the alky chains is of considerable significance to fully explore its photovoltaic potential. In this work, the optimization of alkyl chains is performed on a chlorinated nonfullerene acceptor (NFA) named BTP-4Cl-BO (a Y6 derivative) and very impressive photovoltaic parameters in OPV cells are obtained. To get more ordered intermolecular packing, the n-undecyl is shortened at the edge of BTP-eC11 to n-nonyl and n-heptyl. As a result, the NFAs of BTP-eC9 and BTP-eC7 are synthesized. The BTP-eC7 shows relatively poor solubility and thus limits its application in device fabrication. Fortunately, the BTP-eC9 possesses good solubility and, at the same time, enhanced electron transport property

than BTP-eC11. Significantly, due to the simultaneously enhanced short-circuit current density and fill factor, the BTP-eC9-based single-junction OPV cells record a maximum PCE of 17.8% and get a certified value of 17.3%. These results demonstrate that minimizing the alkyl chains to get suitable solubility and enhanced intermolecular packing has a great potential in further improving its photovoltaic performance.

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15 被引频次: 218

题目: 3D PRINTING OF CERAMICS: A REVIEW

作者: CHEN, ZW; LI, ZY; LI, JJ; LIU, CB; LAO, CS; FU, YL; LIU, CY; LI, Y; WANG, P; HE, Y

出处: JOURNAL OF THE EUROPEAN CERAMIC SOCIETY 39 (4): 661-687 APR 2019

摘要: Along with extensive research on the three-dimensional (3D) printing of polymers and metals, 3D printing of ceramics is now the latest trend to come under the spotlight. The ability to fabricate ceramic components of arbitrarily complex shapes has been extremely challenging without 3D printing. This review focuses on the latest advances in the 3D printing of ceramics and presents the historical origins and evolution of each related technique. The main technical aspects, including feedstock properties, process control, post-treatments and energy source material interactions, are also discussed. The technical challenges and advice about how to address these are presented. Comparisons are made between the techniques to facilitate the selection of the best ones in practical use. In addition, representative applications of the 3D printing of various types of ceramics are surveyed. Future directions are pointed out on the advancement on materials and forming mechanism for the fabrication of high-performance ceramic components.

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16 被引频次: 218

题目: VAN DER WAALS INTEGRATION BEFORE AND BEYOND TWO-DIMENSIONAL MATERIALS

作者: LIU, Y; HUANG, Y; DUAN, XF 出处: NATURE 567 (7748): 323-333 MAR 21 2019

摘要: Material integration strategies, such as epitaxial growth, usually involve strong chemical bonds and are typically limited to materials with strict structure matching and processing compatibility. Van der Waals integration, in which pre-fabricated building blocks are physically assembled together through weak van der Waals interactions, offers an alternative bond-free integration strategy without lattice and processing limitations, as exemplified by two-dimensional van der Waals heterostructures. Here we review the development, challenges and opportunities of

this emerging approach, generalizing it for flexible integration of diverse material systems beyond two dimensions, and discuss its potential for creating artificial heterostructures or superlattices beyond the reach of existing materials.

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17 被引频次: 218

题目: FUNDAMENTALS OF INORGANIC SOLID-STATE ELECTROLYTES FOR BATTERIES

作者: FAMPRIKIS, T; CANEPA, P; DAWSON, JA; ISLAM, MS; MASQUELIER, C

出处: NATURE MATERIALS 18 (12): 1278-1291 DEC 2019

摘要: In the critical area of sustainable energy storage, solid-state batteries have attracted considerable attention due to their potential safety, energy-density and cycle-life benefits. This Review describes recent progress in the fundamental understanding of inorganic solid electrolytes, which lie at the heart of the solid-state battery concept, by addressing key issues in the areas of multiscale ion transport, electrochemical and mechanical properties, and current processing routes. The main electrolyte-related challenges for practical solid-state devices include utilization of metal anodes, stabilization of interfaces and the maintenance of physical contact, the solutions to which hinge on gaining greater knowledge of the underlying properties of solid electrolyte materials.

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18 被引频次: 216

题目: 17% EFFICIENT ORGANIC SOLAR CELLS BASED ON LIQUID EXFOLIATED WS<sub>2</sub> AS A REPLACEMENT FOR PEDOT:PSS

作者: LIN, YB; ADILBEKOVA, B; FIRDAUS, Y; YENGEL, E; FABER, H; SAJJAD, M; ZHENG, XP; YARALI, E; SEITKHAN, A; BAKR, OM; EL-LABBAN, A; SCHWINGENSCHLOGL, U; TUNG, V; MCCULLOCH, I; LAQUAI, F; ANTHOPOULOS, TD

出处: ADVANCED MATERIALS 31 (46): - NOV 2019

摘要: The application of liquid-exfoliated 2D transition metal disulfides (TMDs) as the hole transport layers (HTLs) in nonfullerene-based organic solar cells is reported. It is shown that solution processing of few-layer WS<sub>2</sub> or MoS<sub>2</sub> suspensions directly onto transparent indium tin oxide (ITO) electrodes changes their work function without the need for any further treatment.



HTLs comprising WS<sub>2</sub> are found to exhibit higher uniformity on ITO than those of MoS<sub>2</sub> and consistently yield solar cells with superior power conversion efficiency (PCE), improved fill factor (FF), enhanced short-circuit current (J(SC)), and lower series resistance than devices based on poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) and MoS<sub>2</sub>. Cells based on the ternary bulk-heterojunction PBDB-T-2F:Y6:PC71BM with WS<sub>2</sub> as the HTL exhibit the highest PCE of 17%, with an FF of 78%, open-circuit voltage of 0.84 V, and a J(SC) of 26 mA cm<sup>-2</sup>. Analysis of the cells' optical and carrier recombination characteristics indicates that the enhanced performance is most likely attributed to a combination of favorable photonic structure and reduced bimolecular recombination losses in WS<sub>2</sub>-based cells. The achieved PCE is the highest reported to date for organic solar cells comprised of 2D charge transport interlayers and highlights the potential of TMDs as inexpensive HTLs for high-efficiency organic photovoltaics.

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19 被引频次: 215

题目: PEROVSKITE LEAD-FREE DIELECTRICS FOR ENERGY STORAGE APPLICATIONS

作者: YANG, LT;KONG, X;LI, F;HAO, H;CHENG, ZX;LIU, HX;LI, JF;ZHANG, SJ

出处: PROGRESS IN MATERIALS SCIENCE 102: 72-108 MAY 2019

摘要: The projected increase in world energy consumption within the next 50 years, coupled with low emission requirements, has inspired an enormous effort towards the development of efficient, clean, and renewable energy sources. Efficient electrical energy storage solutions are keys to effective implementation of the electricity generated from these renewable sources. In step with the development of energy storage technology and the power electronics industry, dielectric materials with high energy density are in high demand. The dielectrics with a medium dielectric constant, high breakdown strength, and low polarization hysteresis are the most promising candidates for high-power energy storage applications. Inspiring energy densities have been achieved in current dielectrics, but challenges exist for practical applications, where the underlying mechanisms need to be understood for further enhancing their properties to meet future energy requirements. In this review, we summarize the principles of dielectric energy-storage applications, and recent developments on different types of dielectrics, namely linear dielectrics, paraelectrics, ferroelectrics, and antiferroelectrics, are surveyed, focusing on perovskite lead-free dielectrics. The new achievements of polymer-ceramic composites in energy-storage applications are also reviewed. The pros and cons of each type of dielectric, the existing challenges, and future perspectives are presented and discussed with respect to specific applications.

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20 被引频次: 215

题目: DIAGNOSING COVID-19: THE DISEASE AND TOOLS FOR DETECTION

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出处: ACS NANO 14 (4): 3822-3835 APR 28 2020

摘要: COVID-19 has spread globally since its discovery in Hubei province, China in December 2019. A combination of computed tomography imaging, whole genome sequencing, and electron microscopy were initially used to screen and identify SARS-CoV-2, the viral etiology of COVID-19. The aim of this review article is to inform the audience of diagnostic and surveillance technologies for SARS-CoV-2 and their performance characteristics. We describe point-of-care diagnostics that are on the horizon and encourage academics to advance their technologies beyond conception. Developing plug-and-play diagnostics to manage the SARS-CoV-2 outbreak would be useful in preventing future epidemics.

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21 被引频次: 214

题目: ADHESIVE HEMOSTATIC CONDUCTING INJECTABLE COMPOSITE HYDROGELS WITH SUSTAINED DRUG RELEASE AND PHOTOTHERMAL ANTIBACTERIAL ACTIVITY TO PROMOTE FULL-THICKNESS SKIN REGENERATION DURING WOUND HEALING

作者: LIANG, YP;ZHAO, X;HU, TL;CHEN, BJ;YIN, ZH;MA, PX;GUO, BL

出处: SMALL 15 (12): - MAR 22 2019

摘要: Developing injectable nanocomposite conductive hydrogel dressings with multifunctions including adhesiveness, antibacterial, and radical scavenging ability and good mechanical property to enhance full-thickness skin wound regeneration is highly desirable in clinical application. Herein, a series of adhesive hemostatic antioxidant conductive photothermal antibacterial hydrogels based on hyaluronic acid-graft-dopamine and reduced graphene oxide (rGO) using a H<sub>2</sub>O<sub>2</sub>/HPR (horseradish peroxidase) system are prepared for wound dressing. These hydrogels exhibit high swelling, degradability, tunable rheological property, and similar or superior mechanical properties to human skin. The polydopamine endowed antioxidant activity, tissue adhesiveness and hemostatic ability, self-healing ability, conductivity, and NIR irradiation enhanced in vivo antibacterial behavior of the hydrogels are investigated. Moreover, drug release

and zone of inhibition tests confirm sustained drug release capacity of the hydrogels. Furthermore, the hydrogel dressings significantly enhance vascularization by upregulating growth factor expression of CD31 and improve the granulation tissue thickness and collagen deposition, all of which promote wound closure and contribute to a better therapeutic effect than the commercial Tegaderm films group in a mouse full-thickness wounds model. In summary, these adhesive hemostatic antioxidative conductive hydrogels with sustained drug release property to promote complete skin regeneration are an excellent wound dressing for full-thickness skin repair.

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22 被引频次: 214

题目: 16.67% RIGID AND 14.06% FLEXIBLE ORGANIC SOLAR CELLS ENABLED BY TERNARY HETEROJUNCTION STRATEGY

作者: YAN, TT; SONG, W; HUANG, JM; PENG, RX; HUANG, LK; GE, ZY

出处: ADVANCED MATERIALS 31 (39): - SEP 2019

摘要: Ternary heterojunction strategies appear to be an efficient approach to improve the efficiency of organic solar cells (OSCs) through harvesting more sunlight. Ternary OSCs are fabricated by employing wide bandgap polymer donor (PM6), narrow bandgap nonfullerene acceptor (Y6), and PC71BM as the third component to tune the light absorption and morphologies of the blend films. A record power conversion efficiency (PCE) of 16.67% (certified as 16.0%) on rigid substrate is achieved in an optimized PM6:Y6:PC71BM blend ratio of 1:1:0.2. The introduction of PC71BM endows the blend with enhanced absorption in the range of 300-500 nm and optimises interpenetrating morphologies to promote photogenerated charge dissociation and extraction. More importantly, a PCE of 14.06% for flexible ITO-free ternary OSCs is obtained based on this ternary heterojunction system, which is the highest PCE reported for flexible state-of-the-art OSCs. A very promising ternary heterojunction strategy to develop highly efficient rigid and flexible OSCs is presented.

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23 被引频次: 214

题目: 3D BIOPRINTING OF COLLAGEN TO REBUILD COMPONENTS OF THE HUMAN HEART

作者: LEE, A; HUDSON, AR; SHIWARSKI, DJ; TASHMAN, JW; HINTON, TJ; YERNENI,



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出处: SCIENCE 365 (6452): 482-+ SP. ISS. SI AUG 2 2019

摘要: Collagen is the primary component of the extracellular matrix in the human body. It has proved challenging to fabricate collagen scaffolds capable of replicating the structure and function of tissues and organs. We present a method to 3D-bioprint collagen using freeform reversible embedding of suspended hydrogels (FRESH) to engineer components of the human heart at various scales, from capillaries to the full organ. Control of pH-driven gelation provides 20-micrometer filament resolution, a porous microstructure that enables rapid cellular infiltration and microvascularization, and mechanical strength for fabrication and perfusion of multiscale vasculature and tri-leaflet valves. We found that FRESH 3D-bioprinted hearts accurately reproduce patient-specific anatomical structure as determined by micro-computed tomography. Cardiac ventricles printed with human cardiomyocytes showed synchronized contractions, directional action potential propagation, and wall thickening up to 14% during peak systole.

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24 被引频次: 207

题目: QUANTIFYING THE TRIBOELECTRIC SERIES

作者: ZOU, HY;ZHANG, Y;GUO, LT;WANG, PH;HE, X;DAI, GZ;ZHENG, HW;CHEN, CY;WANG, AC;XU, C;WANG, ZL

出处: NATURE COMMUNICATIONS 10: - MAR 29 2019

摘要: Triboelectrification is a well-known phenomenon that commonly occurs in nature and in our lives at any time and any place. Although each and every material exhibits triboelectrification, its quantification has not been standardized. A triboelectric series has been qualitatively ranked with regards to triboelectric polarization. Here, we introduce a universal standard method to quantify the triboelectric series for a wide range of polymers, establishing quantitative triboelectrification as a fundamental materials property. By measuring the tested materials with a liquid metal in an environment under well-defined conditions, the proposed method standardizes the experimental set up for uniformly quantifying the surface triboelectrification of general materials. The normalized triboelectric charge density is derived to reveal the intrinsic character of polymers for gaining or losing electrons. This quantitative triboelectric series may serve as a textbook standard for implementing the application of triboelectrification for energy harvesting and self-powered sensing.

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25 被引频次: 206

题目: CARBON-BASED METAL-FREE ORR ELECTROCATALYSTS FOR FUEL CELLS: PAST, PRESENT, AND FUTURE 作者: YANG, LJ;SHUI, JL;DU, L;SHAO, YY;LIU, J;DAI, LM;HU, Z

出处: ADVANCED MATERIALS 31 (13): - MAR 27 2019

摘要: Replacing precious platinum with earth-abundant materials for the oxygen reduction reaction (ORR) in fuel cells has been the objective worldwide for several decades. In the last 10 years, the fastest-growing branch in this area has been carbon-based metal-free ORR electrocatalysts. Great progress has been made in promoting the performance and understanding the underlying fundamentals. Here, a comprehensive review of this field is presented by emphasizing the emerging issues including the predictive design and controllable construction of porous structures and doping configurations, mechanistic understanding from the model catalysts, integrated experimental and theoretical studies, and performance evaluation in full cells. Centering on these topics, the most up-to-date results are presented, along with remarks and perspectives for the future development of carbon-based metal-free ORR electrocatalysts.

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## *ESI HIGHLY CITED PAPERS*

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(来源: <http://esi.incites.thomsonreuters.com>)

1 被引频次: 8763

题目: ELECTRONICS AND OPTOELECTRONICS OF TWO-DIMENSIONAL TRANSITION METAL DICHALCOGENIDES

作者: WANG, QH;KALANTAR-ZADEH, K;KIS, A;COLEMAN, JN;STRANO, MS

出处: NATURE NANOTECHNOLOGY 7 (11): 699-712 NOV 2012

摘要: The remarkable properties of graphene have renewed interest in inorganic, two-dimensional materials with unique electronic and optical attributes. Transition metal dichalcogenides (TMDCs) are layered materials with strong in-plane bonding and weak out-of-plane interactions enabling exfoliation into two-dimensional layers of single unit cell thickness. Although TMDCs have been studied for decades, recent advances in nanoscale materials characterization and device fabrication have opened up new opportunities for two-dimensional layers of thin TMDCs in nanoelectronics and optoelectronics. TMDCs such as MoS<sub>2</sub>, MoSe<sub>2</sub>, WS<sub>2</sub> and WSe<sub>2</sub> have sizable bandgaps that change from indirect to direct in single layers, allowing applications such as transistors, photodetectors and electroluminescent devices. We review the historical development of TMDCs, methods for preparing atomically thin layers, their electronic and optical properties, and prospects for future advances in electronics and optoelectronics.

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2 被引频次: 8681

题目: SINGLE-LAYER MOS<sub>2</sub> TRANSISTORS

作者: RADISAVLJEVIC, B;RADENOVIC, A;BRIVIO, J;GIACOMETTI, V;KIS, A

出处: NATURE NANOTECHNOLOGY 6 (3): 147-150 MAR 2011

摘要: Two-dimensional materials are attractive for use in next-generation nanoelectronic devices because, compared to one-dimensional materials, it is relatively easy to fabricate complex structures from them. The most widely studied two-dimensional material is graphene(1,2), both because of its rich physics(3-5) and its high mobility(6). However, pristine graphene does not have a bandgap, a property that is essential for many applications, including transistors(7). Engineering a graphene bandgap increases fabrication complexity and either reduces mobilities to the level of

strained silicon films(8-13) or requires high voltages(14,15). Although single layers of MoS<sub>2</sub> have a large intrinsic bandgap of 1.8 eV (ref. 16), previously reported mobilities in the 0.5-3 cm<sup>2</sup> V<sup>-1</sup> s<sup>-1</sup> range(17) are too low for practical devices. Here, we use a hafnium oxide gate dielectric to demonstrate a room-temperature single-layer MoS<sub>2</sub> mobility of at least 200 cm<sup>2</sup> V<sup>-1</sup> s<sup>-1</sup>, similar to that of graphene nanoribbons, and demonstrate transistors with room-temperature current on/off ratios of 1 x 10<sup>8</sup> and ultralow standby power dissipation. Because monolayer MoS<sub>2</sub> has a direct bandgap(16,18), it can be used to construct interband tunnel FETs<sup>19</sup>, which offer lower power consumption than classical transistors. Monolayer MoS<sub>2</sub> could also complement graphene in applications that require thin transparent semiconductors, such as optoelectronics and energy harvesting.

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3 被引频次: 5851

题目: LI-O<sub>2</sub> AND LI-S BATTERIES WITH HIGH ENERGY STORAGE

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出处: NATURE MATERIALS 11 (1): 19-29 JAN 2012

摘要: Li-ion batteries have transformed portable electronics and will play a key role in the electrification of transport. However, the highest energy storage possible for Li-ion batteries is insufficient for the long-term needs of society, for example, extended-range electric vehicles. To go beyond the horizon of Li-ion batteries is a formidable challenge; there are few options. Here we consider two: Li-air (O<sub>2</sub>) and Li-S. The energy that can be stored in Li-air (based on aqueous or non-aqueous electrolytes) and Li-S cells is compared with Li-ion; the operation of the cells is discussed, as are the significant hurdles that will have to be overcome if such batteries are to succeed. Fundamental scientific advances in understanding the reactions occurring in the cells as well as new materials are key to overcoming these obstacles. The potential benefits of Li-air and Li-S justify the continued research effort that will be needed.

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4 被引频次: 4945

题目: LEAD IODIDE PEROVSKITE SENSITIZED ALL-SOLID-STATE SUBMICRON THIN FILM MESOSCOPIC SOLAR CELL WITH EFFICIENCY EXCEEDING 9%

作者: KIM, HS; LEE, CR; IM, JH; LEE, KB; MOEHL, T; MARCHIORO, A; MOON, SJ; HUMPHRY-BAKER, R; YUM, JH; MOSER, JE; GRATZEL, M; PARK, NG

出处: SCIENTIFIC REPORTS 2: - AUG 21 2012

摘要: We report on solid-state mesoscopic heterojunction solar cells employing nanoparticles (NPs) of methyl ammonium lead iodide (CH<sub>3</sub>NH<sub>3</sub>)PbI<sub>3</sub> as light harvesters. The perovskite NPs were produced by reaction of methylammonium iodide with PbI<sub>2</sub> and deposited onto a



submicron-thick mesoscopic TiO<sub>2</sub> film, whose pores were infiltrated with the hole-conductor spiro-MeOTAD. Illumination with standard AM-1.5 sunlight generated large photocurrents ( $J(SC)$ ) exceeding 17 mA/cm<sup>2</sup>), an open circuit photovoltage ( $V-OC$ ) of 0.888 V and a fill factor ( $FF$ ) of 0.62 yielding a power conversion efficiency ( $PCE$ ) of 9.7%, the highest reported to date for such cells. Femto second laser studies combined with photo-induced absorption measurements showed charge separation to proceed via hole injection from the excited (CH<sub>3</sub>NH<sub>3</sub>)PbI<sub>3</sub> NPs into the spiro-MeOTAD followed by electron transfer to the mesoscopic TiO<sub>2</sub> film. The use of a solid hole conductor dramatically improved the device stability compared to (CH<sub>3</sub>NH<sub>3</sub>)PbI<sub>3</sub> -sensitized liquid junction cells.

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5 被引频次: 4554

题目: BLACK PHOSPHORUS FIELD-EFFECT TRANSISTORS

作者: LI, LK;YU, YJ;YE, GJ;GE, QQ;OU, XD;WU, H;FENG, DL;CHEN, XH;ZHANG, YB

出处: NATURE NANOTECHNOLOGY 9 (5): 372-377 MAY 2014

摘要: Two-dimensional crystals have emerged as a class of materials that may impact future electronic technologies. Experimentally identifying and characterizing new functional two-dimensional materials is challenging, but also potentially rewarding. Here, we fabricate field-effect transistors based on few-layer black phosphorus crystals with thickness down to a few nanometres. Reliable transistor performance is achieved at room temperature in samples thinner than 7.5 nm, with drain current modulation on the order of 10<sup>5</sup> and well-developed current saturation in the I-V characteristics. The charge-carrier mobility is found to be thickness-dependent, with the highest values up to similar to 1,000 cm<sup>2</sup> V<sup>-1</sup> s<sup>-1</sup> obtained for a thickness of similar to 10nm. Our results demonstrate the potential of black phosphorus thin crystals as a new two-dimensional material for applications in nanoelectronic devices.

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6 被引频次: 4304

题目: TWO-DIMENSIONAL NANOSHEETS PRODUCED BY LIQUID EXFOLIATION OF LAYERED MATERIALS

作者: COLEMAN, JN;LOTYA, M;ONEILL, A;BERGIN, SD;KING, PJ;KHAN, U;YOUNG, K;GAUCHER, A;DE, S;SMITH, RJ;SHVETS, IV;ARORA, SK;STANTON, G;KIM, HY;LEE, K;KIM, GT;DUESBERG, GS;HALLAM, T;BOLAND, JJ;WANG, JJ;DONEGAN, JF;GRUNLAN, JC;MORIARTY, G;SHMELIOV, A;NICHOLLS, RJ;PERKINS,

JM;GRIEVESON, EM;THEUWISSEN, K;MCCOMB, DW;NELLIST, PD;NICOLOSI, V

出处: SCIENCE 331 (6017): 568-571 FEB 4 2011

摘要: If they could be easily exfoliated, layered materials would become a diverse source of two-dimensional crystals whose properties would be useful in applications ranging from electronics to energy storage. We show that layered compounds such as MoS(2), WS(2), MoSe(2), MoTe(2), TaSe(2), NbSe(2), NiTe(2), BN, and Bi(2)Te(3) can be efficiently dispersed in common solvents and can be deposited as individual flakes or formed into films. Electron microscopy strongly suggests that the material is exfoliated into individual layers. By blending this material with suspensions of other nanomaterials or polymer solutions, we can prepare hybrid dispersions or composites, which can be cast into films. We show that WS(2) and MoS(2) effectively reinforce polymers, whereas WS(2)/carbon nanotube hybrid films have high conductivity, leading to promising thermoelectric properties.

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7 被引频次: 4243

题目: LONG-RANGE BALANCED ELECTRON- AND HOLE-TRANSPORT LENGTHS IN ORGANIC-INORGANIC CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>

作者: XING, GC;MATHEWS, N;SUN, SY;LIM, SS;LAM, YM;GRATZEL, M;MHAISALKAR, S;SUM, TC

出处: SCIENCE 342 (6156): 344-347 OCT 18 2013

摘要: Low-temperature solution-processed photovoltaics suffer from low efficiencies because of poor exciton or electron-hole diffusion lengths (typically about 10 nanometers). Recent reports of highly efficient CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>-based solar cells in a broad range of configurations raise a compelling case for understanding the fundamental photophysical mechanisms in these materials. By applying femtosecond transient optical spectroscopy to bilayers that interface this perovskite with either selective-electron or selective-hole extraction materials, we have uncovered concrete evidence of balanced long-range electron-hole diffusion lengths of at least 100 nanometers in solution-processed CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>. The high photoconversion efficiencies of these systems stem from the comparable optical absorption length and charge-carrier diffusion lengths, transcending the traditional constraints of solution-processed semiconductors.

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8 被引频次: 4026

题目: SOLVENT ENGINEERING FOR HIGH-PERFORMANCE INORGANIC-ORGANIC HYBRID PEROVSKITE SOLAR CELLS

作者: JEON, NJ;NOH, JH;KIM, YC;YANG, WS;RYU, S;SEOK, SI

出处: NATURE MATERIALS 13 (9): 897-903 SEP 2014

摘要: Organolead trihalide perovskite materials have been successfully used as light absorbers in efficient photovoltaic cells. Two different cell structures, based on mesoscopic metal oxides and planar heterojunctions have already demonstrated very impressive advances in performance. Here, we report a bilayer architecture comprising the key features of mesoscopic and planar structures obtained by a fully solution-based process. We used  $\text{CH}_3\text{NH}_3\text{Pb}(\text{I}_{1-x}\text{Br}_x)_3$  ( $x = 0.1-0.15$ ) as the absorbing layer and poly(triarylamine) as a hole-transporting material. The use of a mixed solvent of gamma-butyrolactone and dimethylsulphoxide (DMSO) followed by toluene drop-casting leads to extremely uniform and dense perovskite layers via a  $\text{CH}_3\text{NH}_3\text{I-PbI}_2\text{-DMSO}$  intermediate phase, and enables the fabrication of remarkably improved solar cells with a certified power-conversion efficiency of 16.2% and no hysteresis. These results provide important progress towards the understanding of the role of solution-processing in the realization of low-cost and highly efficient perovskite solar cells.

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9 被引频次: 3975

题目:  $\text{Co}_3\text{O}_4$  NANOCRYSTALS ON GRAPHENE AS A SYNERGISTIC CATALYST FOR OXYGEN REDUCTION REACTION

作者: LIANG, YY;LI, YG;WANG, HL;ZHOU, JG;WANG, J;REGIER, T;DAI, HJ

出处: NATURE MATERIALS 10 (10): 780-786 OCT 2011

摘要: Catalysts for oxygen reduction and evolution reactions are at the heart of key renewable-energy technologies including fuel cells and water splitting. Despite tremendous efforts, developing oxygen electrode catalysts with high activity at low cost remains a great challenge. Here, we report a hybrid material consisting of  $\text{Co}_3\text{O}_4$  nanocrystals grown on reduced graphene oxide as a high-performance bi-functional catalyst for the oxygen reduction reaction (ORR) and oxygen evolution reaction (OER). Although  $\text{Co}_3\text{O}_4$  or graphene oxide alone has little catalytic activity, their hybrid exhibits an unexpected, surprisingly high ORR activity that is further enhanced by nitrogen doping of graphene. The  $\text{Co}_3\text{O}_4/\text{N-doped graphene}$  hybrid exhibits similar catalytic activity but superior stability to Pt in alkaline solutions. The same hybrid is also highly active for OER, making it a high-performance non-precious metal-based bi-catalyst for both ORR and OER. The unusual catalytic activity arises from synergetic chemical coupling effects between  $\text{Co}_3\text{O}_4$  and graphene.

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10 被引频次: 3520

题目: PHOSPHORENE: AN UNEXPLORED 2D SEMICONDUCTOR WITH A HIGH HOLE MOBILITY

作者: LIU, H;NEAL, AT;ZHU, Z;LUO, Z;XU, XF;TOMANEK, D;YE, PD

出处: ACS NANO 8 (4): 4033-4041 APR 2014

摘要: We introduce the 2D counterpart of layered black phosphorus, which we call phosphorene, as an unexplored p-type semiconducting material. Same as graphene and MoS<sub>2</sub>, single-layer phosphorene is flexible and can be mechanically exfoliated. We find phosphorene to be stable and, unlike graphene, to have an inherent, direct, and appreciable band gap. Our ab initio calculations indicate that the band gap is direct, depends on the number of layers and the in-layer strain, and is significantly larger than the bulk value of 0.31-0.36 eV. The observed photoluminescence peak of single-layer phosphorene in the visible optical range confirms that the band gap is larger than that of the bulk system. Our transport studies indicate a hole mobility that reflects the structural anisotropy of phosphorene and complements n-type MoS<sub>2</sub>. At room temperature, our few-layer phosphorene field-effect transistors with 1.0 μm channel length display a high on-current of 194 mA/mm, a high hole field-effect mobility of 286 cm<sup>2</sup>/V.s, and an on/off ratio of up to 10<sup>4</sup>. We demonstrate the possibility of phosphorene integration by constructing a 2D CMOS inverter consisting of phosphorene PMOS and MoS<sub>2</sub> NMOS transistors.

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11. 被引频次: 3404

题目: RAMAN SPECTROSCOPY AS A VERSATILE TOOL FOR STUDYING THE PROPERTIES OF GRAPHENE

作者: FERRARI, AC;BASKO, DM

出处: NATURE NANOTECHNOLOGY 8 (4): 235-246 APR 2013

摘要: Raman spectroscopy is an integral part of graphene research. It is used to determine the number and orientation of layers, the quality and types of edge, and the effects of perturbations, such as electric and magnetic fields, strain, doping, disorder and functional groups. This, in turn, provides insight into all sp<sup>2</sup>-bonded carbon allotropes, because graphene is their fundamental building block. Here we review the state of the art, future directions and open questions in Raman spectroscopy of graphene. We describe essential physical processes whose importance has only recently been recognized, such as the various types of resonance at play, and the role of quantum interference. We update all basic concepts and notations, and propose a terminology that is able to describe any result in literature. We finally highlight the potential of Raman spectroscopy for layered materials other than graphene.

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12 被引频次: 3229

题目: THERMAL PROPERTIES OF GRAPHENE AND NANOSTRUCTURED CARBON MATERIALS

作者: BALANDIN, AA

出处: NATURE MATERIALS 10 (8): 569-581 AUG 2011

摘要: Recent years have seen a rapid growth of interest by the scientific and engineering communities in the thermal properties of materials. Heat removal has become a crucial issue for continuing progress in the electronic industry, and thermal conduction in low-dimensional structures has revealed truly intriguing features. Carbon allotropes and their derivatives occupy a unique place in terms of their ability to conduct heat. The room-temperature thermal conductivity of carbon materials span an extraordinary large range - of over five orders of magnitude - from the lowest in amorphous carbons to the highest in graphene and carbon nanotubes. Here, I review the thermal properties of carbon materials focusing on recent results for graphene, carbon nanotubes and nanostructured carbon materials with different degrees of disorder. Special attention is given to the unusual size dependence of heat conduction in two-dimensional crystals and, specifically, in graphene. I also describe the prospects of applications of graphene and carbon materials for thermal management of electronics.

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13 被引频次: 3215

题目: NANOCRYSTALS OF CESIUM LEAD HALIDE PEROVSKITES (CSPBX<sub>3</sub>, X = CL, BR, AND I): NOVEL OPTOELECTRONIC MATERIALS SHOWING BRIGHT EMISSION WITH WIDE COLOR GAMUT

作者: PROTESESCU, L;YAKUNIN, S;BODNARCHUK, MI;KRIEG, F;CAPUTO, R;HENDON, CH;YANG, RX;WALSH, A;KOVALENKO, MV

出处: NANO LETTERS 15 (6): 3692-3696 JUN 2015

摘要: Metal halides perovskites, such as hybrid organic-inorganic CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>, are newcomer optoelectronic materials that have attracted enormous attention as solution-deposited absorbing layers in solar cells with power conversion efficiencies reaching 20%. Herein we demonstrate a new avenue for halide perovskites by designing highly luminescent perovskite-based colloidal quantum dot materials. We have synthesized monodisperse colloidal nanocubes (4-15 nm edge lengths) of fully inorganic cesium lead halide perovskites (CsPbX<sub>3</sub>, X = Cl, Br, and I or mixed halide systems Cl/Br and Br/I) using inexpensive commercial precursors. Through compositional modulations and quantum size-effects, the bandgap energies and emission spectra are readily tunable over the entire visible spectral region of 410-700 nm. The photoluminescence of CsPbX<sub>3</sub> nanocrystals is characterized by narrow emission line-widths of 12-42 nm, wide color gamut covering up to 140% of the NTSC color standard, high quantum

yields of up to 90%, and radiative lifetimes in the range of 1-29 ns. The compelling combination of enhanced optical properties and chemical robustness makes CsPbX<sub>3</sub> nanocrystals appealing for optoelectronic applications, particularly for blue and green spectral regions (410-530 nm), where typical metal chalcogenide-based quantum dots suffer from photodegradation.

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14 被引频次: 3153

题目: STIMULI-RESPONSIVE NANOCARRIERS FOR DRUG DELIVERY

作者: MURA, S; NICOLAS, J; COUVREUR, P

出处: NATURE MATERIALS 12 (11): 991-1003 NOV 2013

摘要: Spurred by recent progress in materials chemistry and drug delivery, stimuli-responsive devices that deliver a drug in spatial-, temporal- and dosage-controlled fashions have become possible. Implementation of such devices requires the use of biocompatible materials that are susceptible to a specific physical incitement or that, in response to a specific stimulus, undergo a protonation, a hydrolytic cleavage or a (supra) molecular conformational change. In this Review, we discuss recent advances in the design of nanoscale stimuli-responsive systems that are able to control drug biodistribution in response to specific stimuli, either exogenous (variations in temperature, magnetic field, ultrasound intensity, light or electric pulses) or endogenous (changes in pH, enzyme concentration or redox gradients).

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15 被引频次: 3053

题目: RESOLVING SURFACE CHEMICAL STATES IN XPS ANALYSIS OF FIRST ROW TRANSITION METALS, OXIDES AND HYDROXIDES: CR, MN, FE, CO AND NI

作者: BIESINGER, MC; PAYNE, BP; GROSVENOR, AP; LAU, LWM; GERSON, AR; SMART, RS

出处: APPLIED SURFACE SCIENCE 257 (7): 2717-2730 JAN 15 2011

摘要: Chemical state X-ray photoelectron spectroscopic analysis of first row transition metals and their oxides and hydroxides is challenging due to the complexity of their 2p spectra resulting from peak asymmetries, complex multiplet splitting, shake-up and plasmon loss structure, and uncertain, overlapping binding energies. Our previous paper [M. C. Biesinger et al., Appl. Surf. Sci. 257 (2010) 887-898.] in which we examined Sc, Ti, V, Cu and Zn species, has shown that all the values of the spectral fitting parameters for each specific species, i.e. binding energy (eV), full width at half maximum (FWHM) value (eV) for each pass energy, spin-orbit splitting values and asymmetric peak shape fitting parameters, are not all normally provided in the literature and data bases, and are necessary for reproducible, quantitative chemical state analysis. A more consistent,

practical and effective approach to curve fitting was developed based on a combination of (1) standard spectra from quality reference samples, (2) a survey of appropriate literature databases and/or a compilation of literature references and (3) specific literature references where fitting procedures are available. This paper extends this approach to the chemical states of Cr, Mn, Fe, Co and Ni metals, and various oxides and hydroxides where intense, complex multiplet splitting in many of the chemical states of these elements poses unique difficulties for chemical state analysis. The curve fitting procedures proposed use the same criteria as proposed previously but with the additional complexity of fitting of multiplet split spectra which has been done based on spectra of numerous reference materials and theoretical XPS modeling of these transition metal species. Binding energies, FWHM values, asymmetric peak shape fitting parameters, multiplet peak separation and peak area percentages are presented. The procedures developed can be utilized to remove uncertainties in the analysis of surface states in nano-particles, corrosion, catalysis and surface-engineered materials. (C) 2010 Elsevier B. V. All rights reserved.

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16 被引频次: 2897

题目: PLASMONIC-METAL NANOSTRUCTURES FOR EFFICIENT CONVERSION OF SOLAR TO CHEMICAL ENERGY

作者: LINIC, S;CHRISTOPHER, P;INGRAM, DB

出处: NATURE MATERIALS 10 (12): 911-921 DEC 2011

摘要: Recent years have seen a renewed interest in the harvesting and conversion of solar energy. Among various technologies, the direct conversion of solar to chemical energy using photocatalysts has received significant attention. Although heterogeneous photocatalysts are almost exclusively semiconductors, it has been demonstrated recently that plasmonic nanostructures of noble metals (mainly silver and gold) also show significant promise. Here we review recent progress in using plasmonic metallic nanostructures in the field of photocatalysis. We focus on plasmon-enhanced water splitting on composite photocatalysts containing semiconductor and plasmonic-metal building blocks, and recently reported plasmon-mediated photo-catalytic reactions on plasmonic nanostructures of noble metals. We also discuss the areas where major advancements are needed to move the field of plasmon-mediated photocatalysis forward.

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17 被引频次: 2887

题目: CARBON NANOTUBES: PRESENT AND FUTURE COMMERCIAL APPLICATIONS

作者: DE VOLDER, MFL;TAWFICK, SH;BAUGHMAN, RH;HART, AJ

出处: SCIENCE 339 (6119): 535-539 FEB 1 2013



摘要: Worldwide commercial interest in carbon nanotubes (CNTs) is reflected in a production capacity that presently exceeds several thousand tons per year. Currently, bulk CNT powders are incorporated in diverse commercial products ranging from rechargeable batteries, automotive parts, and sporting goods to boat hulls and water filters. Advances in CNT synthesis, purification, and chemical modification are enabling integration of CNTs in thin-film electronics and large-area coatings. Although not yet providing compelling mechanical strength or electrical or thermal conductivities for many applications, CNT yarns and sheets already have promising performance for applications including supercapacitors, actuators, and lightweight electromagnetic shields.

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18 被引频次: 2822

题目: SODIUM-ION BATTERIES

作者: SLATER, MD;KIM, D;LEE, E;JOHNSON, CS

出处: ADVANCED FUNCTIONAL MATERIALS 23 (8): 947-958 SP. ISS. SI FEB 25 2013

摘要: The status of ambient temperature sodium ion batteries is reviewed in light of recent developments in anode, electrolyte and cathode materials. These devices, although early in their stage of development, are promising for large-scale grid storage applications due to the abundance and very low cost of sodium-containing precursors used to make the components. The engineering knowledge developed recently for highly successful Li ion batteries can be leveraged to ensure rapid progress in this area, although different electrode materials and electrolytes will be required for dual intercalation systems based on sodium. In particular, new anode materials need to be identified, since the graphite anode, commonly used in lithium systems, does not intercalate sodium to any appreciable extent. A wider array of choices is available for cathodes, including high performance layered transition metal oxides and polyanionic compounds. Recent developments in electrodes are encouraging, but a great deal of research is necessary, particularly in new electrolytes, and the understanding of the SEI films. The engineering modeling calculations of Na-ion battery energy density indicate that 210 Wh kg<sup>-1</sup> in gravimetric energy is possible for Na-ion batteries compared to existing Li-ion technology if a cathode capacity of 200 mAh g<sup>-1</sup> and a 500 mAh g<sup>-1</sup> anode can be discovered with an average cell potential of 3.3 V.

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19 被引频次: 2804

题目: CHEMICAL MANAGEMENT FOR COLORFUL, EFFICIENT, AND STABLE INORGANIC-ORGANIC HYBRID NANOSTRUCTURED SOLAR CELLS

作者: NOH, JH;IM, SH;HEO, JH;MANDAL, TN;SEOK, SI

出处: NANO LETTERS 13 (4): 1764-1769 APR 2013



摘要: Chemically tuned inorganic-organic hybrid materials, based on  $\text{CH}_3\text{NH}_3(\text{MA})\text{Pb}(\text{I}1-\text{xBrx})(3)$  perovskites, have been studied using UV-vis absorption and X-ray diffraction patterns and applied to nanostructured solar cells. The band gap engineering brought about by the chemical management of  $\text{MAPb}(\text{I}1-\text{xBrx})(3)$  perovskites can be controllably tuned to cover almost the entire visible spectrum, enabling the realization of colorful solar cells. We demonstrate highly efficient solar cells exhibiting 12.3% in a power conversion efficiency of under standard AM 1.5, for the most efficient device, as a result of tunable composition for the light harvester in conjunction with a mesoporous  $\text{TiO}_2$  film and a hole conducting polymer. We believe that the works highlighted in this paper represent one step toward the realization of low-cost, high-efficiency, and long-term stability with colorful solar cells.

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20 被引频次: 2802

题目: PROGRESS, CHALLENGES, AND OPPORTUNITIES IN TWO-DIMENSIONAL MATERIALS BEYOND GRAPHENE

作者: BUTLER, SZ; HOLLEN, SM; CAO, LY; CUI, Y; GUPTA, JA; GUTIERREZ, HR; HEINZ, TF; HONG, SS; HUANG, JX; ISMACH, AF; JOHNSTON-HALPERIN, E; KUNO, M; PLASHNITSA, VV; ROBINSON, RD; RUOFF, RS; SALAHUDDIN, S; SHAN, J; SHI, L; SPENCER, MG; TERRONES, M; WINDL, W; GOLDBERGER, JE

出处: ACS NANO 7 (4): 2898-2926 APR 2013

摘要: Graphene's success has shown that it is possible to create stable, single and few-atom-thick layers of van der Waals materials, and also that these materials can exhibit fascinating and technologically useful properties. Here we review the state-of-the-art of 2D materials beyond graphene. Initially, we will outline the different chemical classes of 2D materials and discuss the various strategies to prepare single-layer, few-layer, and multilayer assembly materials in solution, on substrates, and on the wafer scale. Additionally, we present an experimental guide for identifying and characterizing single-layer-thick materials, as well as outlining emerging techniques that yield both local and global information. We describe the differences that occur in the electronic structure between the bulk and the single layer and discuss various methods of tuning their electronic properties by manipulating the surface. Finally, we highlight the properties and advantages of single-, few-, and many-layer 2D materials in field-effect transistors, spin- and valley-tronics, thermoelectrics, and topological insulators, among many other applications.

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21 被引频次: 2744

题目: ULTRASENSITIVE PHOTODETECTORS BASED ON MONOLAYER MOS<sub>2</sub>

作者: LOPEZ-SANCHEZ, O;LEMBKE, D;KAYCI, M;RADENOVIC, A;KIS, A

出处: NATURE NANOTECHNOLOGY 8 (7): 497-501 JUL 2013

摘要: Two-dimensional materials are an emerging class of new materials with a wide range of electrical properties and potential practical applications. Although graphene(1) is the most well-studied two-dimensional material, single layers of other materials, such as insulating BN (ref. 2) and semiconducting MoS<sub>2</sub> (refs 3,4) or WSe<sub>2</sub> (refs 5,6), are gaining increasing attention as promising gate insulators and channel materials for field-effect transistors. Because monolayer MoS<sub>2</sub> is a direct-bandgap semiconductor(7,8) due to quantum-mechanical confinement(7,9,10), it could be suitable for applications in optoelectronic devices where the direct bandgap would allow a high absorption coefficient and efficient electron-hole pair generation under photo-excitation. Here, we demonstrate ultrasensitive monolayer MoS<sub>2</sub> phototransistors with improved device mobility and ON current. Our devices show a maximum external photoresponsivity of 880 AW<sup>-1</sup> at a wavelength of 561 nm and a photoresponse in the 400-680 nm range. With recent developments in large-scale production techniques such as liquid-scale exfoliation(11-13) and chemical vapour deposition-like growth(14,15), MoS<sub>2</sub> shows important potential for applications in MoS<sub>2</sub>-based integrated optoelectronic circuits, light sensing, biomedical imaging, video recording and spectroscopy.

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22 被引频次: 2699

题目: TWO-DIMENSIONAL NANOCRYSTALS PRODUCED BY EXFOLIATION OF Ti<sub>3</sub>AlC<sub>2</sub>

作者: NAGUIB, M;KURTOGLU, M;PRESSER, V;LU, J;NIU, JJ;HEON, M;HULTMAN, L;GOGOTSI, Y;BARSOUM, MW

出处: ADVANCED MATERIALS 23 (37): 4248-4253 OCT 4 2011

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23 被引频次: 2649

题目: ELECTRON-HOLE DIFFUSION LENGTHS  $> 175 \mu\text{m}$  IN SOLUTION-GROWN  $\text{CH}_3\text{NH}_3\text{PbI}_3$  SINGLE CRYSTALS

作者: DONG, QF;FANG, YJ;SHAO, YC;MULLIGAN, P;QIU, J;CAO, L;HUANG, JS

出处: SCIENCE 347 (6225): 967-970 FEB 27 2015

摘要: Long, balanced electron and hole diffusion lengths greater than 100 nanometers in the polycrystalline organolead trihalide compound  $\text{CH}_3\text{NH}_3\text{PbI}_3$  are critical for highly efficient perovskite solar cells. We found that the diffusion lengths in  $\text{CH}_3\text{NH}_3\text{PbI}_3$  single crystals grown by a solution-growth method can exceed 175 micrometers under 1 sun ( $100 \text{ mW cm}^{-2}$ ) illumination and exceed 3 millimeters under weak light for both electrons and holes. The internal quantum efficiencies approach 100% in 3-millimeter-thick single-crystal perovskite solar cells under weak light. These long diffusion lengths result from greater carrier mobility, longer lifetime, and much smaller trap densities in the single crystals than in polycrystalline thin films. The long carrier diffusion lengths enabled the use of  $\text{CH}_3\text{NH}_3\text{PbI}_3$  in radiation sensing and energy harvesting through the gammavoltaic effect, with an efficiency of 3.9% measured with an intense cesium-137 source.

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24 被引频次: 2599

题目: THREE-DIMENSIONAL FLEXIBLE AND CONDUCTIVE INTERCONNECTED GRAPHENE NETWORKS GROWN BY CHEMICAL VAPOUR DEPOSITION

作者: CHEN, ZP;REN, WC;GAO, LB;LIU, BL;PEI, SF;CHENG, HM

出处: NATURE MATERIALS 10 (6): 424-428 JUN 2011

摘要: Integration of individual two-dimensional graphene sheets(1-3) into macroscopic structures is essential for the application of graphene. A series of graphene-based composites(4-6) and macroscopic structures(7-11) have been recently fabricated using chemically derived graphene sheets. However, these composites and structures suffer from poor electrical conductivity because of the low quality and/or high inter-sheet junction contact resistance of the chemically derived graphene sheets. Here we report the direct synthesis of three-dimensional foam-like graphene macrostructures, which we call graphene foams (GFs), by template-directed chemical vapour deposition. A GF consists of an interconnected flexible network of graphene as the fast transport channel of charge carriers for high electrical conductivity. Even with a GF loading as low as similar to 0.5 wt%, GF/poly(dimethyl siloxane) composites show a very high electrical conductivity of similar to  $10 \text{ S cm}^{-1}$ , which is similar to 6 orders of magnitude higher than chemically derived graphene-based composites(4). Using this unique network structure and the outstanding electrical and mechanical properties of GFs, as an example, we demonstrate the great potential of GF/poly(dimethyl siloxane) composites for flexible, foldable and stretchable conductors(12).

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25 被引频次: 2564

题目: FIRST PRINCIPLES PHONON CALCULATIONS IN MATERIALS SCIENCE

作者: TOGO, A;TANAKA, I

出处: SCRIPTA MATERIALIA 108: 1-5 NOV 2015

摘要: Phonon plays essential roles in dynamical behaviors and thermal properties, which are central topics in fundamental issues of materials science. The importance of first principles phonon calculations cannot be overly emphasized. Phonopy is an open source code for such calculations launched by the present authors, which has been world-widely used. Here we demonstrate phonon properties with fundamental equations and show examples how the phonon calculations are applied in materials science. (C) 2015 Acta Materialia Inc. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

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## AIAA、IAF 最新会议

### AIAA

(AIAA 来源: <http://www.aiaa.org/>)

1. 会议名称: The American Rocketry Challenge

会议时间: 15 June - 30 June 2021

会议地点: The Plains, Virginia

会议简介: Organized by AIA and the National Association of Rocketry, provides high school students with an opportunity to compete in the nation's largest student rocket competition. AIAA is proud to support this program by providing technical mentors and the opportunity to expose students to rocket challenges, fun, and the comradery that underpins the aerospace profession.

链接:

<https://www.aiaa.org/events-learning/event/2021/06/15/default-calendar/the-american-rocketry-challenge>

2. 会议名称: 32nd Congress of the International Council of the Aeronautical Sciences

会议时间: 6 September - 10 September 2021

会议地点: Shanghai, China

会议简介: ICAS is an international, non-government, non-profit scientific organization with the mission to advance knowledge and facilitate collaboration in aeronautics. ICAS is the only international support organization to representative aeronautical engineering professional societies and their members in 30 countries. ICAS organizes every two years an International Congress covering all aspects of aeronautical science and technology and their application to both military and civil aviation.

链接:

[https://www.aiaa.org/events-learning/event/2021/09/06/default-calendar/32nd-congress-of-the-international-council-of-the-aeronautical-sciences-\(icas\)](https://www.aiaa.org/events-learning/event/2021/09/06/default-calendar/32nd-congress-of-the-international-council-of-the-aeronautical-sciences-(icas))

3. 会议名称: 2021 AIAA Defense and Security Forum

会议时间: 14 September - 16 September 2021

会议地点: Laurel, Maryland, USA

会议简介: The 2021 forum will bring together government, military, industry, and academia to discuss the strategic, programmatic, and technical topics and policy issues in aerospace and defense.

链接:

<https://www.aiaa.org/events-learning/event/2021/09/14/default-calendar/2021-aiaa-defense-forum>

**4. 会议名称:** ASCEND - Accelerating Space Commerce, Exploration, and New Discovery  
**会议时间:** 15 November - 17 November 2021  
**会议地点:** Las Vegas, Nevada & ONLINE  
**会议简介:** Building a sustainable off-world future requires the collective effort of a diverse global community of students and professionals with the ideas, skills and passions to solve complex problems and inspire new ways of thinking. That's why more than 3,000 technical experts, executives, entrepreneurs, and engineers — from classrooms through careers — attended the inaugural 2020 ASCEND last November. Plan now to join us for the 2021 edition. The universe is expanding, and ASCEND is your space.  
**链接:** <https://www.aiaa.org/events-learning/event/2021/11/15/default-calendar/ascend-2021>

**5.会议名称:** AIAA International Space Planes and Hypersonic Systems and Technologies Conference  
**会议时间:** 15 November - 17 November 2021  
**会议地点:** Las Vegas, Nevada & ONLINE  
**会议简介:** The 24th AIAA International Space Planes and Hypersonic Systems and Technologies Conference, as a part of ASCEND 2021, provides a forum for discussion and exchange of information for attendees from across the globe about leading-edge research and development activities associated with space planes and hypersonic atmospheric flight vehicles and the technologies underpinning these capabilities. Presentations will be provided on national programs from North America, South America, Australia, Europe, and Asia and multiple opportunities for international collaboration will be discussed.  
**链接:**  
<https://www.aiaa.org/events-learning/event/2021/11/15/default-calendar/24th-aiaa-international-space-planes-and-hypersonic-systems-and-technologies-conference>

## IAF

(IAF 来源: <http://www.iafastro.org/>)

**会议名称:** 72nd International Astronautical Congress 2021  
**会议时间:** 25-29 October 2021  
**会议地点:** Dubai, United Arab Emirates  
**会议简介:** For the very first time, the IAC will open its doors to the global space community in the United Arab Emirates, the first Arab country to host the IAC since its establishment in 1950. The United Arab Emirates' interest in astronomy and space sciences dates back to the 1970's, when His Highness Sheikh Zayed bin Sultan Al Nahyan met with the NASA team responsible for the Apollo moon landing. This encounter sparked a national focus on space that began almost three decades ago, eventually leading to the birth of a national space sector. The IAC 2021 Host Organization – the Mohammed Bin Rashid Space Center (MBRSC) – member of the IAF since 2012, was established by the Dubai Government to serve as one of the main pillars to drive the establishment of the knowledge economy and sustainable development in the UAE.





With the theme “Inspire, Innovate & Discover for the Benefit of Humankind”, the IAC 2021 looks forward to making a contribution to humanity and to science by strengthening and enhancing cooperation between all countries in the space sector.

This is your chance to inspire the next generation, to architect the further development and expansion of the space sector’s growing ecosystem. In fact, the IAC 2021 could be your opportunity to contribute in breakthroughs that revolutionise the future of space exploration.

The IAC 2021 comes to the UAE at a fortuitous juncture: it will follow closely on the heels of the launch of the Emirates Mars Mission (Hope Probe), the Arab’s first space exploration craft to Mars. It will also mark the anniversary of the return of the first Emirati astronaut from the International Space Station, and the second anniversary of the launch of KhalifaSat — the first Earth-observation satellite to be produced wholly by Emiratis. These achievements are symbolic of the beginning of a new era in the region; the IAC 2021 will be an opportunity to shed light on how space science and technology can contribute to a nation’s progress.

链接: <https://www.iafastro.org/events/iac/iac-2021/>



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## ACM 最新会议

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来源：<http://www.acm.org/>

1. 会议名称：14th ACM Conference on Security and Privacy in Wireless and Mobile Networks

会议时间：June 28 to July 2, 2021

会议地点：New York University Abu Dhabi, UAE

会议简介：ACM is the world's largest educational and scientific computing society. ACM WiSec is the leading ACM and SIGSAC conference dedicated to all aspects of security and privacy in wireless and mobile networks and their applications, mobile software platforms, Internet of Things, cyber-physical systems, usable security and privacy, biometrics, and cryptography. ACM WiSec is a very competitive, high-quality conference, and is very-well attended by industry, government, and academia to share information, network, explore ideas, and learn about emerging trends and today's hottest and most provocative cybersecurity topics. This event is a great opportunity for like-minded colleagues, researchers, students, and industry to attend and learn about the current advances in the security and privacy field. We are looking forward to welcoming you virtually in Abu Dhabi this year!

链接：<https://sites.nyuad.nyu.edu/wisec21/>

2. 会议名称：The Genetic and Evolutionary Computation Conference

会议时间：July 10-14, 2021

会议地点：Online

会议简介：The Genetic and Evolutionary Computation Conference (GECCO) presents the latest high-quality results in genetic and evolutionary computation since 1999. Topics include: genetic algorithms, genetic programming, ant colony optimization and swarm intelligence, complex systems (artificial life, robotics, evolvable hardware, generative and developmental systems, artificial immune systems), digital entertainment technologies and arts, evolutionary combinatorial optimization and metaheuristics, evolutionary machine learning, evolutionary multiobjective optimization, evolutionary numerical optimization, real world applications, search-based software engineering, theory and more.

链接：<https://gecco-2021.sigev.org/HomePage>

3. 会议名称：The 12th ACM Conference on Bioinformatics, Computational Biology, and Health Informatics

会议时间：August 1-4, 2021

会议地点：online

会议简介：The ACM-BCB is a premier dissemination forum for interdisciplinary research linking computer science, mathematics, statistics, biology, bioinformatics, biomedical informatics, and

health informatics. The past few decades have seen tremendous growth in the scale and complexity of biological and medical data including recent mainstream recognition of big data challenges. This conference serves to showcase leading-edge research on new technologies and techniques around gathering, processing, analyzing, and modeling of data and information for a variety of scientific, clinical, and healthcare applications, from bench to bedside.

链接: <https://acm-bcb.org/2021/index.php>

4. 会议名称: ITC 33 - Networked Systems and Services

会议时间: Aug. 31st - Sep. 3rd 2021

会议地点: Avignon, France

会议简介: The International Teletraffic Congress ITC 33, to be held 31/08-03/09 2021, at the Avignon University, France, is the 33th edition of this international flagship congress in the field of networking science and practice. ITC was founded back in 1955 by enthusiastic scientists and engineers who were willing to deploy networks in a holistic way. Since then, it has established a multi-decade tradition as the primary forum for presenting and discussing the latest technical advances in the broad areas of teletraffic models, network systems, and measurements. ITC 33 focuses on the future networks taking advantage of 5G and artificial intelligence (AI), towards “AI-integrated Networks”. Indeed, service providers from all over the world are already reaping the benefits of integrating AI into their networks. For ITC 33, cutting-edge papers spanning both theory and experimentation are solicited in all areas of networking, ranging from traffic engineering and control with application also to emerging softwarized/virtualized network paradigms, up to innovative wireless scenarios brought about by the emergence of 5G and IoT systems. We especially encourage original contributions which bridge the gap between performance modeling and real-life operational aspects, including works which leverage measurement data to provide a better understanding of the wired and wireless networks’ operation under realistic conditions.

链接: <https://itc33.org/>

5. 会议名称: 16th International Conference on the Foundations of Digital Games (FDG) 2021

会议时间: 2-6 August, 2021

会议地点: online

会议简介: The 16th International Conference on the Foundations of Digital Games (FDG) 2021 is proud to invite research contributions in the form of papers, games and demos, doctoral consortium applications, as well as panel, competition, and workshop proposals. We invite contributions from within and across any discipline committed to advancing knowledge on the foundations of games: computer science and engineering, humanities and social sciences, arts and design, mathematics and natural sciences. Papers and Games-and-Demos submissions will receive double-blind peer reviews. Workshops, panels, competitions, and all other submissions will be single-blind. Games and Demos are guaranteed two reviews. There will be no rebuttal. The FDG 2021 proceedings will be published with the ACM Digital Library.

链接: <http://fdg2021.org/>

6. 会议名称: ESEC/FSE 2021

会议时间: Mon 23 - Sat 28 August 2021

会议地点: Athens, Greece

会议简介: The ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (ESEC/FSE) is an internationally renowned forum for researchers, practitioners, and educators to present and discuss the most recent innovations, trends, experiences, and challenges in the field of software engineering. ESEC/FSE brings together experts from academia and industry to exchange the latest research results and trends as well as their practical application in all areas of software engineering.

链接: <https://2021.esec-fse.org/>

7. 会议名称: Mobile HCI 2021

会议时间: Sept. 27 - Oct. 1, 2021

会议地点: Toulouse, France & virtually

会议简介: After over 20 years of shaping research, development and practice in mobile devices and services, MobileHCI updates its name and becomes the ACM International Conference on Mobile Human-Computer Interaction. As we enter a new decade, this conference series is adapting to reflect the societal and technological transition where mobility has become pervasive and prime to our lives. Our community and work is ever more relevant as we bring together academics, designers, and practitioners from multiple disciplines to discuss the challenges and future of people interacting with and through technologies, applications, and services in a mobile world. Attendees will hear from world-leading experts in research talks and workshops; see, touch, and feel new mobile experiences in our demo and poster sessions; as well as be inspired by industry and academic thought-leaders during our panels; while still having time to network and form future collaborations. MobileHCI 2021 welcomes contributions related to any aspect of mobile Human-Computer Interaction, from technology, to user experience, methodology, theoretical contributions, and beyond. Our conference also solicits proposals for workshops, demonstrations, tutorials, and industrial case study papers. We look forward to seeing you in Toulouse in September 2021!

链接: <https://mobilehci.acm.org/2021/>

8. 会议名称: The inaugural Conference on Equity and Access in Algorithms, Mechanisms, and Optimization

会议时间: October 5-9, 2021

会议地点: Virtual

会议简介: The inaugural ACM conference on Equity and Access in Algorithms, Mechanisms, and Optimization (EAAMO '21) aims to highlight work where techniques from algorithms, optimization, and mechanism design, along with insights from the social sciences and humanistic studies, can help improve equity and access to opportunity for historically disadvantaged and underserved communities. The conference will provide an international forum for presenting research papers, problem pitches, survey and position papers, new datasets, and software demonstrations towards the goal of bridging research and practice. Read more about us below.

链接: <https://eaamo.org/>



9. 会议名称: ACM/IEEE 24th International Conference on Model Driven Engineering Languages and Systems

会议时间: Sun 10 - Fri 15 October 2021

会议地点: virtual

会议简介: MODELS is the premier conference series for model-based software and systems engineering. Since 1998, MODELS has covered all aspects of modeling, from languages and methods, to tools and applications. Attendees of MODELS come from diverse backgrounds, including researchers, academics, engineers and industrial professionals. MODELS 2021 is a forum for participants to exchange cutting-edge research results and innovative practical experiences around modeling and model-based software and systems. This year's edition will provide an opportunity for the modeling community to further advance the foundations of modeling, and come up with innovative applications of modeling in emerging areas of cyber-physical systems, embedded systems, socio-technical systems, cloud computing, big data, machine learning, security, open source, and sustainability. In 2021, MODELS has a special theme on "Modeling for Human-AI Collaborative Society". We especially encourage contributions where model-driven engineering intersects with research and applications on, not exclusively, artificial intelligence, Internet of Things, smart cities, robot ethics and value-based Software Engineering.

链接: <https://conf.researchr.org/home/models-2021>

10. 会议名称: 54th IEEE/ACM International Symposium on Microarchitecture

会议时间: October 16 - 20, 2021

会议地点: Athens, Greece

会议简介: The IEEE/ACM International Symposium on Microarchitecture® is the premier forum for presenting, discussing, and debating innovative microarchitecture ideas and techniques for advanced computing and communication systems. This symposium brings together researchers in fields related to microarchitecture, compilers, chips, and systems for technical exchange on traditional microarchitecture topics and emerging research areas. The MICRO community has enjoyed a close interaction between academic researchers and industrial designers, and we aim to continue this tradition at MICRO-54. In 2021, MICRO goes to Athens, Greece.

链接: <https://www.microarch.org/micro54/>

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## *IQPC 最新国防会议(Defence)*

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IQPC 来源: <http://www.iqpc.com/>

**1.会议名称:** International Fighter Conference

**会议时间:** 2-4 November 2021

**会议地点:** London

**会议简介:** The International Fighter Conference will take place in London in 2021 and the programme is currently in development. Previously in 2020 we discussed the future of Combat Air Power across the spectrum of operations. The utility of Combat Air, air-integration into multi-domain operations, and continuing interest in both next generation and light attack platforms calls for a broad range of discussion suited to the 250 attendees that gather each year from both large and small air forces alike. The Conference, now in its 19th year, has built a reputation as the world's premier event for all elements of the fighter aircraft community, with attendance spanning from the Americas, Europe, the Middle East and parts of Asia. Investment in expensive high-end platforms needs to be balanced with a requirement for platforms adept and efficient in low-intensity conflict. What is consistent is that information and connectivity is at the heart of operations. This year's wide-ranging programme uniquely covers the key and emerging issues related to airpower delivery for military leaders and industry. Over the few conference days, we will exchange perspectives and gain insights towards meeting the challenges of operations now and in the future, addressing integration of next generation assets with existing platforms, light attack aircraft, electro-magnetic spectrum dominance, cyber integration, advanced training, LVC, cost-effective capability development, disruptive technologies and mission planning. The next generation programmes, including FCAS, Tempest, and F-X will be discussed and will provide an incredible opportunity to revolutionise airpower delivery and open the door for international opportunities.

**链接:**

[https://www.defenceiq.com/events-internationalfighter/?utm\\_medium=portal&mac=IQPCCORP](https://www.defenceiq.com/events-internationalfighter/?utm_medium=portal&mac=IQPCCORP)

**2.会议名称:** C2ISR USA

**会议时间:** NOVEMBER 08 - 10, 2021

**会议地点:** USA

**会议简介:** The ISR and C2 Battle Management USA conference serves as a landmark strategic forum for the Five Eyes partners, bringing more than 150 representatives from DoD, Navy, Army, Air Force, Marine Corps and Joint Staff together with defense industry leaders. It is part of Defence IQ's world-leading ISR portfolio, the overall aim of which is to deliver and to sustain a decisive information and decision-making advantage for combat forces across every warfighting domain - from space to cyberspace, from air to the seabed.

**链接:** [https://www.defenceiq.com/events-isrusa/?utm\\_medium=portal&mac=IQPCCORP](https://www.defenceiq.com/events-isrusa/?utm_medium=portal&mac=IQPCCORP)



**3.会议名称:** Deployed Medical & Healthcare Delivery

**会议时间:** 23 - 25 November, 2021

**会议地点:** London

**会议简介:** DMHD Forum is currently in production for later this year - previously the event was organised with the support of Defence Medical Services, UK MoD, Deployed Medical and Healthcare Delivery is the flagship opportunity for clinicians, organisational thinkers and capability planners to drive clinical delivery for the battlefield of the future. As doctrine adapts to meet the peer threat, the military medical community must improve capability across the Operational Patient Care Pathway - from point of injury through to definitive care. DMHD will be the only conference to look across that pathway, with a three day programme that asks how clinical care can be delivered in accordance with accepted clinical timelines, on a less dense battlefield and with insecure lines of communication.

**链接:**

[https://www.defenceiq.com/events-deployedmedicalforum/?utm\\_medium=portal&mac=IQPCCO](https://www.defenceiq.com/events-deployedmedicalforum/?utm_medium=portal&mac=IQPCCO)  
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**4.会议名称:** International Armoured Vehicles

**会议时间:** 24 - 27 January, 2022

**会议地点:** Twickenham Stadium, London, United Kingdom

**会议简介:** The annual International Armoured Vehicles Conference (IAVs) has gained a reputation as the world's premier international meeting ground for all elements of the armoured community. IAVs has established itself among the world's Armies, Marine Corps, procurement officials, and industry representatives as the unbiased quality forum to focus solely upon land vehicles and force protection. Since the first in 2001, we've seen the rapid evolution of land power doctrine and technology. 2001 was the start of an extended period of counter-insurgency and counter-terror fighting, leading to the rapid acquisition of armoured vehicles, innovation in counter-IED technology and the proliferation of unmanned aerial systems. Now, we see the emergence of multi-domain concepts of operation, a reorientation towards high-end peer conflict and the aggressive pursuit of disruptive technologies in AI and Robotics, which are sure to revolutionise and re-energise debate within the land forces community - not least, the armoured vehicles market. Now in its 21st year, the conference has helped contribute to the debate around many timely subjects over the years; charting trends in armoured vehicles, from the rise of the MRAP to the more recent increase in demand for 6x6 and 8x8 wheeled vehicles.

**链接:** <https://www.defenceiq.com/events-internationalarmouredvehicles/about-defence-iq>

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