Physical sciences articles within *Nature Communications*

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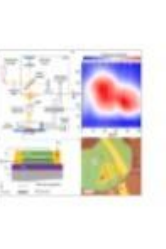
Featured

Article
21 April 2025 | Open Access

Evidence for excitonic condensation and superfluidity in black phosphorus

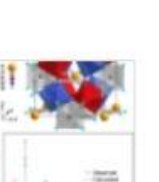


Signatures of excitonic insulators can be challenging to identify. Here, the authors use photocurrent spectroscopy to show signatures of an excitonic insulator and its superfluidity in few layer black phosphorus.

Jiadong Mei, Yuwe Wang & Xiaomu Wang

Article
21 April 2025 | Open Access

High-temperature ferrimagnetic order triggered metal-to-insulator transition in $CaCu_3Ni_2Os_2O_{12}$



Insulator-to-metal transitions induced by spontaneous magnetization above room temperature have rarely been observed. Here, the authors show that this transition, along with concurrent high-temperature ferrimagnetic order, is realized in the novel 3d/5d hybridized quadruple perovskite oxide $CaCu_3Ni_2Os_2O_{12}$.

Xubin Ye, Yunyu Yin & Youwen Long

Article
21 April 2025 | Open Access

Unlocking the phase evolution of the hidden non-polar to ferroelectric transition in HfO_2-based bulk crystals

The underlying formation mechanism and evolution of the ferroelectric phase in hafnium dioxide-based crystals is under debate. Here, the authors characterize the phase transitions and reveal the accompanying atomic movements in a co-doped crystal.

Shuxian Wang, Yihao Shen & Huaijin Zhang

Article
21 April 2025 | Open Access

Fe(OTf)3 or Photosensitizer-free blue light activated diazo-thioglycoside donors for Iterative and stereoselective glycosylations

Conventional methods for thioglycoside activation often rely on precious and toxic platinum group metals. Here, the authors report a catalytic glycosylation strategy employing diazo-thioglycoside donors activated by earth-abundant iron or photosensitizer-free blue light conditions.

Surya Pratap Singh, Umesh Chaudhary & Indrajeet Sharma

Article
21 April 2025 | Open Access

Metal-organic double layer to stabilize selective multi-carbon electrosynthesis

Here the authors immobilize quaternary ammonium cations on the surface of Cu catalyst to suppress the carbonate precipitation, achieving a Faradaic efficiency of 50% for ethylene product at 200 mA/cm² from CO_2 electroreduction.

Jian Cheng, Ling Chen & Yang Peng

Article
20 April 2025 | Open Access

A framework reforming personalized Internet of Things by federated meta-learning

This article addresses the challenge of training AI models in personalized Internet of Things systems while ensuring data security and privacy. Authors combine federated and meta-learning to improve model training performance, adaptation speed, cost-efficiency, and security against attacks.

Linlin You, Zihan Guo & H. Vincent Poor

Article
20 April 2025 | Open Access

A dynamically phase-adaptive regulating hydrogel promotes ultrafast anti-fibrotic wound healing

It is challenging to achieve scar-free repair of chronic wounds as they often feature the occurrence of multiple healing phases in an unpredictable and nonlinear manner. Here, the authors report a healing phase-adaptive regulating hydrogel that exhibits hierarchically delivering performance for programmed modulation of chronic infected wounds.

Fan Zhang, Haijuan Zhang & Jian Xiao

Article
19 April 2025 | Open Access

Borylated strain rings synthesis via photorearrangements enabled by energy transfer catalysis

Borylated carbocycles occupy a pivotal position as essential components in synthetic chemistry, drug discovery, and materials science. Herein, the authors present a photorearrangement that involves a boron atom enabled by energy transfer catalysis under visible light conditions.

Shu-Sheng Chen, Yu Zheng & Huan-Ming Huang

Article
19 April 2025 | Open Access

Angle-controllable RNA tiles for programable array assembly and RNA sensing

RNA assembly has potential for developing biomaterials with tailored properties and functionalities. Here, the authors report on designed, angle-controllable RNA tiles for programmable 1D and 2D self-assembly of RNA, demonstrating RNA sensing and expanding the library of synthetic RNA nanostructures.

Qi Yang, Xu Chang & Fei Zhang

Article
19 April 2025 | Open Access

Li^+-migration influencing factors and non-destructive life extension of quasi-solid-state polymer electrolytes

Polymer electrolytes are promising but are limited by narrow electrochemical window. Here, authors develop a family of in situ polymerized gel electrolytes with long term stability up to 5.0 V and develop a non-destructive life extension strategy through freezing the cells.

Peiying Li, Jinjin Hao & Weidong Zhou

Article
19 April 2025 | Open Access

Decoupled few-femtosecond phase transitions in vanadium dioxide

Comprehensively understanding the ultrafast dynamics of the insulator-to-metal transition in vanadium dioxide is a long-standing challenge. Here, the authors measure the electronic and structural phase transitions in the first hundred femtoseconds.

Christian Brahms, Lin Zhang & Allan S. Johnson

Article
19 April 2025 | Open Access

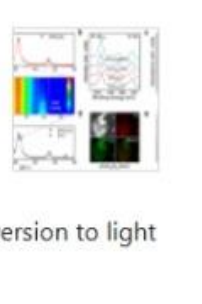
Data-driven discovery of Pt single atom embedded germanosilicate MFI zeolite catalysts for propane dehydrogenation

Zeolite-confined metals are valuable catalysts, but finding a stable metal-zeolite pair with a simple synthesis is challenging. Here, the authors use data-driven simulations to guide the one-pot synthesis of a stable Pt1@Ge-MFI catalyst, achieving high activity, selectivity, and durability in propane dehydrogenation.

Qian-Cheng Zhao, Lin Chen & Zhi-Pan Liu

Article
19 April 2025 | Open Access

ZnO_x overlayer confined on $ZnCr_2O_4$ spinel for direct syngas conversion to light olefins



Identifying active sites on oxide catalysts is often challenging. Here, the authors introduce a syngas-induced dispersion method to anchor ZnO species onto $ZnCr_2O_4$, forming monodispersed ZnO_x active sites that enhance catalytic performance in direct syngas conversion to light olefins.

Xiaohui Feng, Haoran Jia & Xinhe Bao

Article
19 April 2025 | Open Access

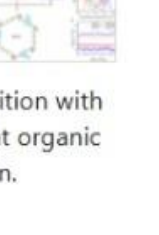
Anion intercalation enables efficient and stable carboxylate upgrading via aqueous non-Kolbe electrolysis

Here, the authors propose an anion intercalation strategy to mitigate the stability problem of aqueous non-Kolbe electrolysis, which enables the efficient upgrading of carboxylate salts to value-added chemicals.

Xinyan Zhang, Laihao Luo & Jie Zeng

Article
19 April 2025 | Open Access

Multivariate covalent organic frameworks with tailored electrostatic potential promote nitrate electroreduction to ammonia in acid



Ammonia electrosynthesis from nitrate reduction direct in acid is restricted by intense competition with hydrogen evolution. Here, a heterogeneous catalyst adlayer composed of multivariate covalent organic frameworks is reported to regulate the microenvironment and promote acidic nitrate reduction.

Qiyang Cheng, Sisi Liu & Jianmei Lu

Article
19 April 2025 | Open Access

Exploring and expanding the natural chemical space of bacterial diterpenes

Unlike that in plants, fungi, and marine animals, bacteria are vastly underrepresented in the production of terpenoids. Here, the authors report a systematic screening of terpene synthases from bacteria and identify three new skeletons that are not found in other organisms.

Xiuting Wei, Wenbo Ning & Jeffrey D. Rudolf

Article
18 April 2025 | Open Access

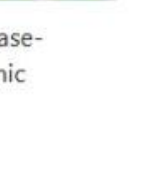
Zero-field Hall effect emerging from a non-Fermi liquid in a collinear antiferromagnet $V_{1/3}NbS_2$

Magnetically intercalated transition metal dichalcogenides provide a platform to study the interplay of magnetism, electronic band structures, and correlations. Here the authors demonstrate a nearly magnetization-free anomalous Hall effect, collinear antiferromagnetism and non-Fermi liquid behavior in $V_{1/3}NbS_2$.

Mayukh Kumar Ray, Mingxuan Fu & Satoru Nakatsuji

Article
18 April 2025 | Open Access

Infrared beam-shaping on demand via tailored geometric phase metasurfaces employing the plasmonic phase-change material In_3SbTe_2

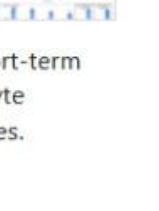


Direct programming of functional metasurfaces is demonstrated by locally crystallizing the phase-change material In_3SbTe_2 via laser irradiation. In_3SbTe_2 is established as a versatile nanophotonic platform for beam steering, lensing, and holography.

Lukas Conrads, Florian Bontke & Thomas Taubner

Article
18 April 2025 | Open Access

Manipulation of lithium dendrites based on electric field relaxation enabling safe and long-life lithium-ion batteries

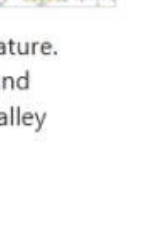


Dendrite growth harms the safety and longevity of Li-ion batteries. Here, authors find that short-term relaxation after lithium plating boosts capacity retention by forming a beneficial solid electrolyte interphase and smoothing morphologies, providing an approach for safe and long-life batteries.

Xuebing Han, Shuoyuan Mao & Minggao Ouyang

Article
18 April 2025 | Open Access

Spin-valley coupling enhanced high-T_C ferromagnetism in a non-van der Waals monolayer Cr_2Se_3 on graphene

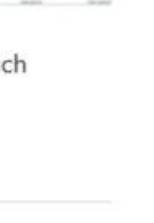


In most van der Waals ferromagnets, reducing the number of layers reduces the Curie temperature. Here, Chuang et al., find that Cr_2Se_3 has an increased Curie temperature for thinner samples, and through angle-resolved photoemission spectroscopy they attribute this to differences in the valley carrier density in different thickness samples.

C.-W. Chuang, T. Kawakami & T. Sato

Article
18 April 2025 | Open Access

High-frequency supercapacitors surpassing dynamic limit of electrical double layer effects

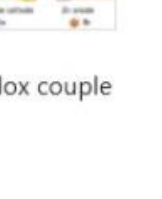


The characteristic frequency of electrochemical supercapacitors is limited by ion dynamics of electrical double layer. Here, authors propose a hybrid design of electrochemical and electrolytic capacitors, operating over 44 kHz, that enables it to surpass such limitation.

Zhongshanhao Li, Minghao Xu & Xiaohong Wang

Article
18 April 2025 | Open Access

Six-electron-conversion selenium cathodes stabilized by dead-selenium revitalizer for aqueous zinc batteries



Developing chemistries for positive electrodes with large specific capacities and high operating potentials is highly desirable for aqueous zinc batteries. Here, authors report a reversible Se electrode that undergoes $ZnSe\rightleftharpoons Se\rightleftharpoons SeCl_4$ reaction, combined with Br^-/Br^{n-} redox couple as Se revitalizer to enhance cycling performance.

Jingwei Du, Jiaxu Zhang & Minghao Yu

Article
18 April 2025 | Open Access

Covalently reactive microparticles imbibe blood to form fortified clots for rapid hemostasis and prevention of rebleeding

Hemostatic failure and the risk of rebleeding present significant challenges. Here, Chen et al. design a covalently reactive hemostat based on blood-imbibing and -crosslinking microparticles, achieving rapid hemostasis and preventing rebleeding.

Ting Chen, Chaonan Xiao & Linyong Zhu

Article
18 April 2025 | Open Access

Ferromagnetism in $LaFeO_3/LaNiO_3$ superlattices with high Curie temperature

Perovskite oxides, when combined into heterostructures and superlattices can yield emergent properties not present in the constituent components. Here, by combining $LaNiO_3$, a Pauli paramagnetic metal, with $LaFeO_3$, an antiferromagnetic insulator, Zhou et al create a strongly ferromagnetic superlattice with a Curie temperature of over 600 K.

Tianlin Zhou, Fei Gao & Baogen Shen

Article
18 April 2025 | Open Access

Organic magnetic nanoparticles catalyze CO_2 capture in hydrogen-bonded nanocages via water-driven crystallization

Water as a precursor is induced by recyclable organic magnetic nanoparticles to construct hydrogen-bonded nanocages. Sustainable CO_2 capture can be achieved by these reversible hydrogen-bonded water cages with zero resource depletion.

Tian Wang, Aliakbar Hassanpouryouzband & Yongchen Song

Article
17 April 2025 | Open Access

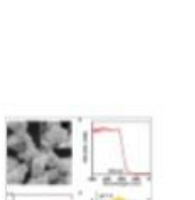
Pushing the limit of layered transition metal oxides with heterolattice oxygen-mediated redox for capacitive deionization

Activation of lattice oxygen–metal configurations in transition metal oxide-based capacitive deionization systems can enhance their performance but requires high voltages. Here the authors enhanced the capacitive deionization performance by developing a V_2O_5/V_2CO_2 heterostructure that can activate oxygen redox at low voltage (<2 V).

Zehao Zhang, Xingtao Xu & Haibo Li

Article
17 April 2025 | Open Access

Tunable multi-electron redox polyoxometalates for decoupled water splitting driven by sunlight



Designing efficient redox mediators for solar-to-fuel conversion is a challenge, requiring multi-electron transfer, suitable redox potential, and stable pH buffering. Here, the authors report polyoxometalate-based mediators with defect engineering, enabling reliable solar-to-fuel conversion.

Li-Ping Cui, Shu Zhang & Jia-Jia Chen

Article
17 April 2025 | Open Access

Aerobic oxidative bromination and iodination enabled by alloxan and ascorbic acid to mimic flavin-dependent halogenases

Flavin-dependent halogenases (FDHs) in nature produce organic halides under benign conditions, yet their practical application remains elusive and difficult to scale up. Inspired by FDHs, here the authors develop a biomimetic aerobic oxidative halogenation strategy that uses oxygen from the air to oxidize non-toxic halide salts.

Shiqi Zhang, Guang-xun Li & Zhuo Tang

Article
17 April 2025 | Open Access

Bridging mixed potential theory and electrochemical promotion of thermal catalysis during hydroquinone-benzoquinone redox reactions

Thermal catalysis can be studied using electrochemical tools. Using hydroquinone oxidation, this study explored the effects of electrical bias and the results suggest that specific reaction condition can induce promotional kinetic effects.

Xingyu Qi, Keisuke Obata & Kazuhiro Takanabe

Article
17 April 2025 | Open Access

Room-temperature multiferroicity in sliding van der Waals semiconductors with sub-0.3 V switching

The authors observe out-of-plane ferroelectric polarization induced by interlayer sliding in a multiferroic van der Waals semiconductor. The switching voltage scales down to 0.3 V at room temperature, which promises low-power device applications.

Rui Chen, Fanhao Meng & Jie Yao

Article
17 April 2025 | Open Access

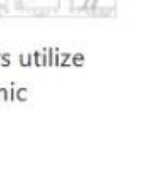
Estimating the quasi-Fermi level of holes at the surface of semiconductor photoanodes using outer-sphere redox couples

Quasi-Fermi levels are crucial parameters for photoelectrochemical reactions. Here, the authors utilize outer-sphere redox reactions to estimate them at the surface of photoanodes, enabling dynamic monitoring of photoelectrode's oxidation capability.

Yuu Shioiri, Keisuke Obata & Kazuhiro Takanabe

Article
17 April 2025 | Open Access

Heterocycle-based dynamic covalent chemistry for dynamic functional materials

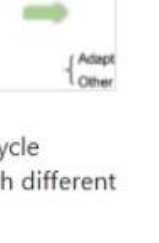


Reusable and degradable thermoset polymers are prepared by dynamic covalent chemistry, but the dynamic bonds rarely provide additional functions to the materials. Here, the authors show a reversible aza-Michael addition reaction between functional heterocycle dihydropyrimidin-2(1H)-thione and electron-deficient olefins providing polymer structures with different functions.

Zeyu Ma, Siyu Pan & Lei Tao

Article
17 April 2025 | Open Access

Single-shot magnon interference in a magnon-superconducting-resonator hybrid circuit

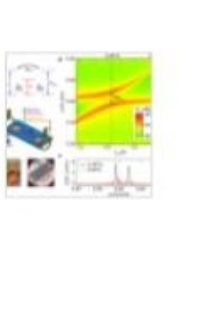


Cavity magnonics aims to make use of magnons, spin waves for coherent information processing. Here, Song et al demonstrate single-shot magnon interference between two remote YIG spheres, showing controlled perfect constructive and destructive interference.

Moojune Song, Tomas Polakovic & Yi Li

Article
17 April 2025 | Open Access

Understanding ultrafast free-rising bubble capturing on nano/micro-structured super-aerophilic surfaces

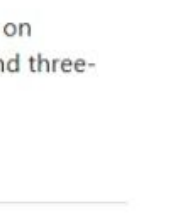


Rapid and stable bubble capture is crucial for gas collection and impurity removal in aquatic systems, yet the role of microtextures in initiating this process remains underexplored. The authors demonstrate that rising bubbles deform the entrapped gas layer on nano/microstructured surfaces, enabling ultrafast and stable capture via liquid film rupture and three-phase contact line hysteresis.

Yue Hu, Zhenbo Xu & Lu-Wen Zhang

Article
17 April 2025 | Open Access

Bis-indole chiral architectures for asymmetric catalysis



Chiral scaffolds are essential to the advancement of asymmetric synthesis, yet the development of new, privileged motifs that more effectively communicate asymmetry constitutes a challenge. Here the authors report the synthesis of enantiopure indole-based axially spirocyclic scaffolds, and their application as organocatalysts or ligands in asymmetric reactions.

Junshan Lai, Benjamin List & Jolene P. Reid

Article
17 April 2025 | Open Access

High-dimensional non-Abelian holonomy in integrated photonics

This work realizes high-dimensional SO(m) non-Abelian holonomy in integrated photonics for both classical and quantum optics realms and demonstrates the application of geometric phase-based linear optical computation.

Youlve Chen, Yunru Fan & Xuhan Guo

Article
17 April 2025 | Open Access

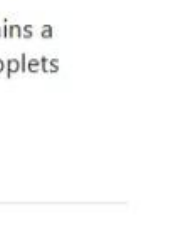
Filming evolution dynamics of Hg nanodroplets mediated at solid-gas and solid-liquid interfaces by in-situ TEM

The in-situ visualization of the evolution of metal nanodroplets at multiphase interfaces remains a challenge. Here, the authors directly observe the motion and jetting behaviors of Hg nanodroplets regulated at solid-gas and solid-liquid interfaces.

Linfeng Xu, Zetan Cao & Bin Chen

Article
17 April 2025 | Open Access

Producing aryl halides from lignin



Depolymerization and transformation of lignin into aryl halides, which are indispensable chemicals in both the academic and industrial communities, remain challenging. Here, the authors report a simple and mild method for the depolymerization and halogenation of lignin, leading to the production of useful aryl halides.

Yongqian Liu, Yi Li & Bing Tian

Article
17 April 2025 | Open Access

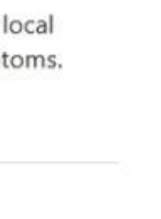
Realization of fractional-layer transition metal dichalcogenides

Layers of transition metal dichalcogenides (TMDs) are generally formed by covalently bonded atoms, enabling mechanical exfoliation only in the out-of-plane direction. Here, the authors show the fabrication of fractional 2/3-layers of WTe_2 and other TMDs by applying local scanning tunneling microscopy tip pulses and controllably removing the topmost chalcogen atoms.

Ya-Xin Zhao, Heng Jin & Lin He

Article
17 April 2025 | Open Access

Large-scale 3D printed fouling-resistant self-floating evaporator



This solar-driven interfacial desalination research integrates 3D printed modules modifications, decoupling design, anticorrosion treatment for high desalination efficiency and long-term stability. This self-floating setup utilizes natural cooling seawater to conduct thermal convection for downward freshwater collection.

Yiru Pu, Wenzhu Lin & Steven Wang

Article
17 April 2025 | Open Access

Fully-gapped superconductivity with rotational symmetry breaking in pressurized kagome metal CsV_3Sb_5

The authors study CsV_3Sb_5 by nuclear quadrupole resonance. At ambient pressure, there are two superconducting gaps with line nodes in the smaller one. For pressures above P_c ~ 1.85 GPa, where the charge-density wave phase is completely suppressed, they observe fully-gapped superconductivity with broken rotational symmetry.

X. Y. Feng, Z. Zhao & Guo-qing Zheng

Article
17 April 2025 | Open Access

Quantifying interactions in the active encounter complex of frustrated Lewis pairs

Sustainable catalysts based on main-group elements, such as frustrated Lewis pairs, have emerged as alternatives to precious metal systems. Here the authors show that the charge-transfer band between $P(mes)_3$ and $B(C_6F_5)_3$ can be analyzed by supramolecular UV-vis spectroscopic techniques to provide the key thermodynamic parameter for the active encounter complex.

Alastair T. Littlewood, Tao Liu & Andrew R. Jupp

Article
17 April 2025 | Open Access

Sub-4 nanometer porous membrane enables highly efficient electrodialytic fractionation of dyes and inorganic salts

Membrane fouling during electrodialysis, nanofiltration and ultrafiltration processes results in a reduction in the dye/salt fractionation efficacy. Here, authors devise an electro-driven filtration process using tight ion-conductive ultrafiltration membrane for one-step, stable dye/salt fractionation.

Jiuyang Lin, Zijian Yu & Yinhua Wan

Article
17 April 2025 | Open Access

Data-driven discovery of biaxially strained single atoms array for hydrogen production

The structure-performance relationship of single-atom catalysts remains unclear. Here a data-driven approach with high-throughput DFT and machine learning is used to screen 1248 single atoms arrays, to provide a better understanding of the hydrogen evolution reaction mechanism.

Tao Zhang, Qitong Ye & Hong Jin Fan

Article
17 April 2025 | Open Access

Harnessing database-supported high-throughput screening for the design of stable interlayers in halide-based all-solid-state batteries

All-solid-state lithium metal batteries face interfacial instability challenges. Here, authors develop a computational screening framework to identify Li_3OCl as a stable interlayer between Li_3InCl_6 electrolyte and the Li metal electrode, improving the capacity retention of all-solid-state batteries.

Longyun Shen, Zilong Wang & Francesco Ciucci

Article
17 April 2025 | Open Access

Direct observation and control of non-classical crystallization pathways in binary colloidal systems

This study reveals how ionic colloidal crystals form through a two-step process, where amorphous blobs condense before transforming into ordered structures. By tuning interactions via continuous dialysis, researchers uncovered new crystal types, including a previously unknown open-framework structure.

Shihao Zang, Sanjib Paul & Stefano Sacanna

Article
16 April 2025 | Open Access

Redefining closed pores in carbons by solvation structures for enhanced sodium storage

Closed pores govern sodium-ion storage performance of hard carbon negative electrodes. Here, authors link pore mouth size evolution of the closed pores to the solvation structure and propose design principles for optimizing both closed pores and intrinsic defects.

Yibo Zhang, Si-Wei Zhang & Quan-Hong Yang

Article
16 April 2025 | Open Access

Hydrogels with prestressed tensegrity structures

Hydrogels are of increasing interest in the materials community, but precise control of mechanochemistry is still challenging. Here, the authors report the use of a tensegrity architecture to prepare hydrogels with favourable properties.

Bin Xue, Xu Han & Yi Cao

Article
16 April 2025 | Open Access

Trivalent Phospha-Brook rearrangement enabled practical deoxygenative phosphonylation of carbonyls

Although Brønsted base-mediated [1,2]- phospha-Brook rearrangements have garnered considerable attention in the development of new methodologies, the strict reliance on pentavalent phosphonates imposes strong limitations on new reaction types. Here, the authors disclose a Lewis acid-mediated trivalent [1,2]- phospha-Brook rearrangement with carbonyl compounds to rapidly access tertiary phosphine oxides.

Xiaoqiang Wu, Shanya Lu & Tao XU

Article
16 April 2025 | Open Access

Reaction-driven formation of anisotropic strains in FeTeSe nanosheets boosts low-concentration nitrate reduction to ammonia

To overcome limitations with anion dissolution, the authors design 2D FeTeSe nanosheets as electrocatalyst. The reaction-driven, in-situ generation of anisotropic in-plane tensile and out-of-plane compressive strains enhances the alkaline low-concentration nitrate reduction.

Jiawei Liu, Yifan Xu & Qingyu Yan

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Nature Communications (*Nat Commun*) ISSN 2041-1723 (online)

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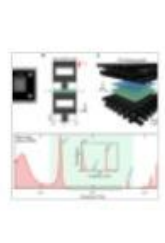
Featured

Article
16 April 2025 | Open Access

Multimode ultrastrong coupling in three-dimensional photonic-crystal cavities



Multimode ultrastrong coupling between 3D photonic-crystal cavity modes and the cyclotron resonance of a 2D electron gas reveals distinct coupling scenarios governed by the cavity's spatial profile and potential intermode ground-state correlations.

Fuyang Tay, Ali Mojibpour & Junichiro Kono

Article
16 April 2025 | Open Access

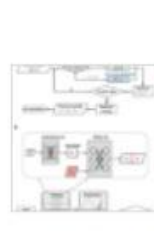
Reverse filling approach to mixed matrix covalent organic framework membranes for gas separation

Mixed-matrix membranes inherit the merits of both polymer materials and filler materials that hold potential for molecular separations, but precisely engineering the filler phase structure remains challenging. Here, the authors describe a reverse-filling approach to fabricate mixed-matrix membranes with continuous and vertically penetrating covalent organic framework channels, which exhibit high CO_2 separation performances, long-term stability and scale-up capability.

Zheyuan Guo, Wenping Li & Zhongyi Jiang

Article
16 April 2025 | Open Access

Probing nuclear quantum effects in electrocatalysis via a machine-learning enhanced grand canonical constant potential approach



Proton-coupled electron transfer reactions are key steps in electrocatalysis. Here the authors introduce a computational method to model such processes including nuclear quantum effects under a grand canonical constant electric potential.

Menglin Sun, Bin Jin & Shenzhen Xu

Article
16 April 2025 | Open Access

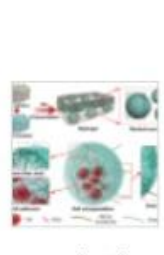
Fluorescent pyridine phosphonium salts via transmutation of metallabenzenes

Metallabenzenes are recognized as a unique class of aromatic compounds, not only of structural and theoretical interest but also as platforms to design powerful transformations. Here, the authors report the successful transmutation of a metallabenzene for pyridine synthesis.

Yaowei Zhang, Feifei Han & Hong Zhang

Article
16 April 2025 | Open Access

Hydrogels with programmed spatiotemporal mechanical cues for stem cell-assisted bone regeneration

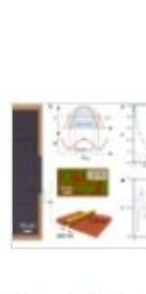


Hydrogels are essential for stem cell-based tissue regeneration but struggle with hard tissue repair. The authors report a shell-hardened macroporous hydrogel with spatiotemporally programmed mechanics to enhance stem cell-driven bone regeneration.

Bin Xue, Zhengyu Xu & Wei Wang

Article
16 April 2025 | Open Access

The effects of disorder in superconducting materials on qubit coherence

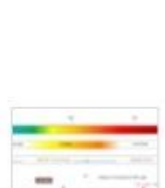


Disorder has emerged as a promising tool to manipulate properties of superconducting circuits. Here the authors demonstrate the use of disordered spinodal superconductor for fluxonium qubit fabrication and reveal an interesting correlation between the material disorder and the 1/f-type flux noise.

Ran Gao, Feng Wu & Chunqing Deng

Article
16 April 2025 | Open Access

Nanoscale heterophase regulation enables sunlight-like full-spectrum white electroluminescence



Chen et al. report a large-area white LED with sunlight-like emission by regulating the heterophase γ/δ-$CsPb(I/Cl)_3$ at nanoscale, in which a fraction of carriers recombines in γ-$CsPbI_3$ for deep-red emission, while other carriers diffuse to the heterophase interface for broadband emission.

Jiawei Chen, Kangyu Ji & Haibo Zeng

Article
16 April 2025 | Open Access

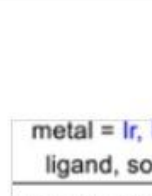
Nanoimprint crystalithography for organic semiconductors

Traditional lithographic techniques could damage organic semiconductor crystals due to high-energy beams or solvents. Here, authors employ a chemical-free nanoimprint crystallography method for fabrication of independent complex 2D patterns that exhibit good lasing performance and reproducibility.

Shun-Xin Li, Guan-Yao Huang & Hong-Bo Sun

Article
16 April 2025 | Open Access

A meta-learning approach for selectivity prediction in asymmetric catalysis

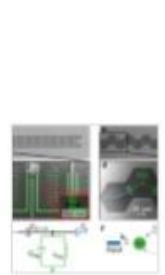


The need for large amount of experimental data can present a bottleneck for implementing machine learning models. Here, the authors propose a meta-learning workflow that can harness the literature-derived data to extract shared reaction features and requires only a few examples to predict the outcome of new reactions.

Sukriti Singh & José Miguel Hernández-Lobato

Article
16 April 2025 | Open Access

High kinetic inductance cavity arrays for compact band engineering and topology-based disorder meters



This study presents a high-impedance, low-disorder, compact coupled cavity array architecture using NbN thin films. To quantify disorder, a metric is developed leveraging the bulk-boundary correspondence of symmetry-protected topological modes.

Vincent Jouanny, Simone Frasca & Pasquale Scarlino

Article
16 April 2025 | Open Access

Integrating physical units into high-performance AI-driven scientific computing

Existing numerical computing libraries lack native support for physical units, limiting their application in rigorous scientific computing. Here, the authors developed SAIUnit, which integrates physical units, and unit-aware mathematical functions and transformations into numerical computing libraries for artificial intelligence-driven scientific computing.

Chaoming Wang, Sichao He & Si Wu

Article
16 April 2025 | Open Access

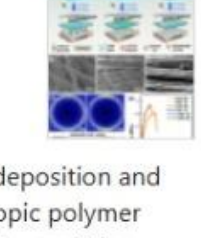
Engineering electro-crystallization orientation and surface activation in wide-temperature zinc ion supercapacitors

Zinc-ion electrochemical cells are limited by cycling stability and low electrode utilization. Here, authors present designs to enhance the cumulative capacity of zinc-ion supercapacitors by reducing zinc dendrites and increasing porous carbon activation, improving capacity and cycle life.

Lulu Yao, Nandu Koripally & Tse Nga Ng

Article
16 April 2025 | Open Access

An anisotropic strategy for developing polymer electrolytes endowing lithium metal batteries with electrochemo-mechanically stable interface



Lithium metal batteries with polymer electrolytes face challenges from uneven lithium deposition and poor mechanical strength of the polymer electrolytes. Here, authors present an anisotropic polymer electrolyte based on oriented polyacrylonitrile nanofibers modified by $Li_{6.4}La_3Zr_{1.4}Ta_{0.6}O_{12}$ particles, achieving a compatible interface with good cycling performance.

Jingren Gou, Kaixuan Cui & Haihui Wang

Article
16 April 2025 | Open Access

Visible light-mediated dearomative spirocyclization/imination of nonactivated arenes through energy transfer catalysis

Partial reduction through dearomative sequences has the potential to provide rapid access to complex and higher-value three-dimensional scaffolds from aromatic compounds. Here, the authors report a photocatalytic radical cascade approach, which exploits dearomative difunctionalization through selective dearomative spirocyclization/imination of nonactivated arenes.

Chao Zhou, Elena V. Stepanova & Peter Dinér

Article
16 April 2025 | Open Access

Divergent evolution of slip banding in CrCoNi alloys

Deformation banding is a common phenomenon in metals, when the external stress surpasses the elastic limit. Here, experiments reveal two strikingly different slip bands that result from the same origin, yet distinct evolution, in stressed advanced alloy.

Bijun Xie, Hangman Chen & Penghui Cao

Article
16 April 2025 | Open Access

An automated framework for assessing how well LLMs cite relevant medical references

Assessing the degree to which medical large language models reliably convey existing, trustworthy knowledge is crucial. This study introduces SourceCheckup, an automated framework revealing that large language models frequently cite medical references that do not fully support, or even contradict, their responses, showing significant gaps in reliability for clinical use.

Kevin Wu, Eric Wu & James Zou

Article
16 April 2025 | Open Access

A modular artificial intelligence framework to facilitate fluorophore design

The fluorophore development used to be dependent on trial-and-error experiments. Here, a modular artificial intelligence framework is built by integrating latest databases, prediction models, and molecule generators to facilitate fluorophore design.

Yuchen Zhu, Jiebin Fang & Linghui Qian

Article
16 April 2025 | Open Access

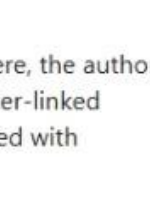
Polycyclic aromatics in the Chang'E 5 lunar soils

The search for lunar polycyclic aromatics is challenging. Here abundance, aromatic structures and carbon isotope composition of polycyclic aromatics in Chang'E 5 lunar soils are reported, shedding light on the fate of polycyclic aromatics and accretion of organic carbon on the Moon.

Guangcai Zhong, Xin Yi & Gan Zhang

Article
16 April 2025 | Open Access

Structure of human MUTYH and functional profiling of cancer-associated variants reveal an allosteric network between its [4Fe-4S] cluster cofactor and active site required for DNA repair



MUTYH removes A mis-incorporated opposite oxidized guanine to thwart mutations. Here, the authors present crystal structures and assess functional impacts and molecular dynamics of cancer-linked variants to illuminate how the [4Fe-4S] cofactor and active site are allosterically connected with significance for fidelity and clinical impact.

Carlos H. Trasviña-Arenas, Upeksha C. Dissanayake & Sheila S. David

Article
16 April 2025 | Open Access

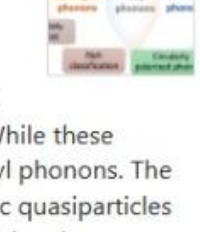
An enzyme-proof glycan glue for extracellular matrix to ameliorate intervertebral disc degeneration

Intervertebral disc degeneration (IDD) is a leading cause of low back pain and disability worldwide. Here, Liu et. al find the loss of protein MFG-E8 from damaged nucleus pulposus tissue plays a role in IDD and design a glycan to enrich endogenous MFG-E8 for IDD treatment.

Yu Liu, Tzuwei Chao & Chunming Wang

Comment
15 April 2025 | Open Access

Weyl phonons: the connection of topology and chirality

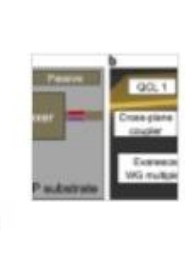


Topology and chirality of fermionic quasiparticles have enabled exciting discoveries, including quantum anomalous Hall liquids and topological superconductivity. Recently, topological and chiral phonons emerge as new and fast-evolving research directions. While these concepts are separately developed, they are intimately connected in the context of Weyl phonons. The couplings between chiral and topological phonons with various electronic and magnetic quasiparticles are predicted to give rise to new quantum states and giant magnetism with fundamental and applicational interests, ranging from quantum information science to dark matter detectors.

Tiantian Zhang, Shuichi Murakami & Hu Miao

Article
15 April 2025 | Open Access

Multi-color photonic integrated circuits based on homogeneous integration of quantum cascade lasers

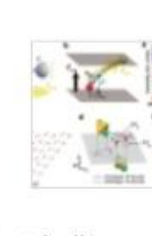


This work reports the first mid-infrared photonic integrated circuit that monolithically integrates distinct quantum cascade laser active regions and wavelength multiplexers on the same InP crystal for multi-wavelength emission.

Dominik Burghart, Kevin Zhang & Mikhail A. Belkin

Article
15 April 2025 | Open Access

Quantifying hydrogen bonding using electrically tunable nanoconfined water

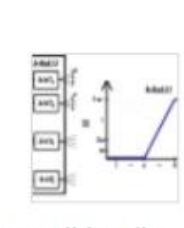


The behavior of confined water is relevant to biological, environmental, and technological systems. Here, researchers model hydrogen bonds as elastic dipoles in an electric field and precisely quantify hydrogen bonding in gypsum heterostructure with electrically tunable confined water.

Ziwei Wang, Anupam Bhattacharya & Artem Mishchenko

Article
15 April 2025 | Open Access

Unconditional advantage of noisy qudit quantum circuits over biased threshold circuits in constant depth



Quantum devices' growth drives efforts to show their benefits. Here, the authors prove unconditionally that constant-depth quantum circuits surpass biased threshold circuits with neural network-like functions for all prime qudit dimensions, even with noise.

Michael de Oliveira, Sathyawageeswar Subramanian & Min-Hsiu Hsieh

Perspective
15 April 2025 | Open Access

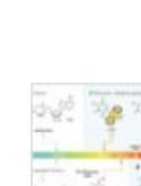
The road to commercial success for neuromorphic technologies

Neuromorphic processors for commercial success require facing challenges in methods for programming neuromorphic applications and deployment at scale. Here, the authors discuss the pathways towards widespread consumer adoption of neuromorphic technology in relation to academia and industry.

Dylan Richard Muir & Sadique Sheik

Article
15 April 2025 | Open Access

Expanding the chemical space of flavins with pentacyclic architecture



Flavins have redox and optical properties applicable to organic, photochemical, and biochemical research, though tailoring these properties remain challenging. Here, the authors report several flavins exhibiting deep-red and NIR emission, and quasi-reversible oxidation.

Dayeong Seo, Seongyeon Kwon & Yunjung Baek

Article
15 April 2025 | Open Access

Stretchable composites with high oxide loading

The authors reported an interfacial composite design that accommodates high oxide fraction and large stretchability, providing implications for developing stretchable composites with enhanced optical, electrical, thermal, and magnetic properties.

Yinglin Zhi, Yan Shao & Yanhao Yu

Article
15 April 2025 | Open Access

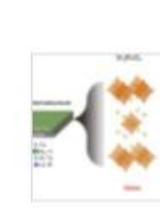
Electrocatalytic N–C–N coupling over a hierarchically ordered open single-atom superstructure toward organonitrogen synthesis

Here, this study report efficient electrocatalytic N–C–N coupling over a hierarchically ordered open superstructure of N-doped carbon isolated with accessible three-coordinated single Zn atoms, achieving sustainable synthesis of organonitrogen compounds.

Yingchun He, Dong-Dong Ma & Qi-Long Zhu

Article
15 April 2025 | Open Access

Tunable magnons of an antiferromagnetic Mott insulator via interfacial metal-insulator transitions

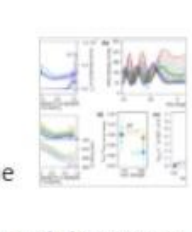


Identifying external mechanisms to tune magnon properties has remained a major challenge. Here, the authors demonstrate that an interfacial metal-insulator transition offers an effective method for controlling the magnon dispersion of Sr_2IrO_4.

Sujan Shrestha, Maryam Souri & Ambrose Seo

Article
15 April 2025 | Open Access

Water flipping and the oxygen evolution reaction on Fe_2O_3 nanolayers



Using second harmonic amplitude and phase measurements the authors characterize the alignment of water molecules in the Stern-layer and the work associated with water flipping on hematite electrodes, suggesting a causal relationship between water flipping and the oxygen evolution reaction overpotential.

Raiden Speelman, Ezra J. Marker & Franz M. Geiger

Article
15 April 2025 | Open Access

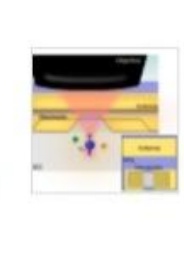
Photocatalytic C-N coupling from stable and transient intermediates for gram-scale acetamide synthesis

This study explores N-heterocyclic carbene copper complexes toward selective electrocatalytic reduction of acetylene to ethylene. The electron-rich copper sites were found to facilitate acetylene adsorption and ethylene desorption and achieved high activity and selectivity for ethylene production.

Xin Li, Weiping Yang & Fan Dong

Article
15 April 2025 | Open Access

Coherent photoelectrical readout of single spins in silicon carbide at room temperature

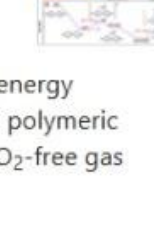


Efficient quantum-state readout is key to quantum technologies. Here, the authors show room-temperature photoelectrical readout of single spins in silicon carbide, with a demonstrated detection efficiency superior to the conventional optical method.

Tetsuri Nishikawa, Naoya Morioka & Norikazu Mizuochi

Article
15 April 2025 | Open Access

A redox-active polymeric network facilitates electrified reactive-capture electrosynthesis to multi-carbon products from dilute CO_2-containing streams



Reactive capture—integrating CO_2 capture and electrochemical valorization—improves energy efficiency by eliminating gas-phase CO_2 desorption. Here, authors design a redox-active polymeric network to boost the direct conversion of captured CO_2 to multicarbon products with CO_2-free gas product stream.

Jinqiang Zhang, Yufei Cao & Edward H. Sargent

Article
15 April 2025 | Open Access

Dispersion hardening using amorphous nanoparticles deployed via additive manufacturing

Crystalline dispersoids are commonly used to strengthen metals by obstructing dislocation movement, but this often comes at the cost of ductility. Here, the authors demonstrate that amorphous nanoparticles, introduced via additive manufacturing, enhance both the tensile strength and fatigue resistance of metallic materials.

Ge Wang, Yin Zhang & Evan Ma

Article
15 April 2025 | Open Access

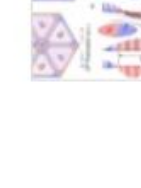
Electrochemical upcycling of uranyl from radioactive organic wastewater with a self-standing covalent-organic framework electrode

Efficient upcycling of uranyl– containing radioactive organic wastewater is of utmost importance for the sustainable development of nuclear energy. Here, authors proposed an indirect electrochemical method to upcycle uranyl from radioactive organic wastewater.

Huihui Jin, Yezi Hu & Xiubing Huang

Article
15 April 2025 | Open Access

Edge polarization topology integrated with sliding ferroelectricity in Moiré system



The authors reveal a complex polarization network in twisted bilayer h-BN, featuring edge polarization topology and sliding ferroelectricity, driven by the interplay of ferroelectric and piezoelectric effects.

Wen-Cheng Fan, Zhao Guan & Chun-Gang Duan

Article
15 April 2025 | Open Access

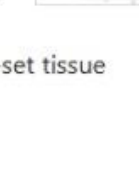
Coincident onset of charge order and pseudogap in a homogeneous high-temperature superconductor

The authors use resonant X-ray scattering to study the cuprate superconductor $YBa_2Cu_4O_8$, which has low disorder due to its stoichiometric nature. They report a diffraction signature of incommensurate, quasi-2D charge order that onsets below $T^* \approx 200$ K, coincident with the pseudogap.

D. Betto, S. Nakata & M. Minola

Article
15 April 2025 | Open Access

Correcting for volunteer bias in GWAS increases SNP effect sizes and heritability estimates

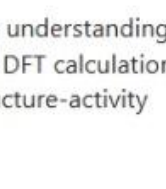


Genetic studies may be biased due to volunteer-based biobanks. Using UK Biobank, the authors apply inverse probability weighting based on UK Census data, finding that genome-wide association studies showed bias in SNP effect sizes, heritability, and gene-set tissue expression.

Sjoerd van Alten, Benjamin W. Domingue & Andries T. Marees

Article
14 April 2025 | Open Access

Revealing the structure-activity relationship of Pt_1/CeO_2 with ^{17}O solid-state NMR spectroscopy and DFT calculations

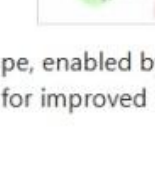


Properly characterizing active sites in single atom catalysts is important for mechanistic understanding but remains difficult. Here the authors combine ^{17}O solid-state NMR spectroscopy and DFT calculations to probe the structures of Pt/CeO_2 single atom catalysts, gaining insights into their structure-activity relationships.

Yujie Wen, Fang Wang & Luming Peng

Article
14 April 2025 | Open Access

Navigation-grade interferometric air-core antiresonant fibre optic gyroscope with enhanced thermal stability



This work presents the first navigation-grade interferometric air-core fibre optic gyroscope, enabled by advanced antiresonant hollow core fibers. This long-sought achievement paves the way for improved environmental adaptability in fibre optic gyroscopes.

Maochun Li, Yizhi Sun & Wei Ding

Article
14 April 2025 | Open Access

Controlled and orthogonal partitioning of large particles into biomolecular condensates

Fundamental biophysical principles that govern particle inclusion in or exclusion from condensates are discovered, wherein arbitrarily large particles controllably partition into condensates given sufficiently strong condensate-particle interactions.

Fleurie M. Kelley, Anas Ani & Benjamin S. Schuster

Article
14 April 2025 | Open Access

Voltage detected single spin dynamics in diamond at ambient conditions

The spin state of color centers in semiconductors can be read out by optical means, but electrical readout is desirable for device applications. Here the authors develop a method for electrical readout of single spins based on the detection of surface photo-voltage and demonstrate it for NV centers in diamond.

Sergei Trofimov, Klaus Lips & Boris Naydenov

Article
14 April 2025 | Open Access

Room-temperature phosphorescence and anomalous piezochromism in molecular crystals enabled by iodine atomic orbital sharing

Modulating room-temperature phosphorescence requires regulating energy and coupling of electronic states. Here the authors show how pressure blue-shifts and enhances emission in molecular crystals by inducing atomic orbital sharing of iodine atoms.

Tongge Xu, Chunguang Zhai & Bingbing Liu

Article
14 April 2025 | Open Access

Electronic band structure engineering of π-d conjugated metal-organic framework for sodium organic batteries

Two-dimensional conjugated metal organic frameworks are potential electrode materials for alkali ion batteries. Here, the authors study two representative framework materials to elucidate the charge storage mechanisms based on metal-ligand coordination and organic linkers.

Juan Chu, Zhaoli Liu & Guangshan Zhu

Article
14 April 2025 | Open Access

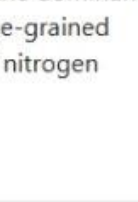
Homogeneous polymer-ionic solvate electrolyte with weak dipole-dipole interaction enabling long cycling pouch lithium metal battery

Solid polymer electrolytes suffer from limited ionic conductivity and poor interfacial stability for lithium batteries. Here, authors propose a fluorinated ether diluent to reduce the dipole-dipole interaction of ionic solvate with the polymer matrix and induce the formation of aggregates.

Likun Chen, Tian Gu & Feiyu Kang

Article
14 April 2025 | Open Access

Bulk Bi-Sb polycrystals underpinned by high electron/phonon mean free path ratio enabling thermoelectric cooling under 77 K



The authors reveal nearly two-order magnitude of decoupling of the mean free path of the dominant electrons to that of phonons in Bi-Sb alloy, achieving an atomically homogeneous, coarse-grained sample through ultrafast quenching, enabling thermoelectric cooling down to the liquid nitrogen regime.

Xiaowei Wu, Zhen Fan & Huaizhou Zhao

Article
14 April 2025 | Open Access

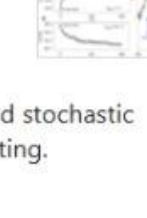
Drugit: crowd-sourcing molecular design of non-peptidic VHL binders

Citizen science taps the efforts of non-experts. Here, authors describe Drugit, an extension of the crowdsourcing game Foldit, and its use in designing a non-peptide binder of Von Hippel Lindau E3 ligase for use with proteolysis targeting chimeras.

Thomas Scott, Christian Alan Paul Smethurst & Rocco Moretti

Article
13 April 2025 | Open Access

Self-organizing neuromorphic nanowire networks as stochastic dynamical systems

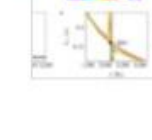


In this work, Milano et al. show that neuromorphic nanowire networks are stochastic dynamical systems where dynamics can be holistically described as an Ornstein-Uhlenbeck process, enabling the investigation of the role of deterministic trajectories and stochastic effects on their computational capabilities in the framework of physical reservoir computing.

Gianluca Milano, Fabio Michieletti & Enrique Miranda

Article
13 April 2025 | Open Access

Exceptional energy harvesting from coupled bound states

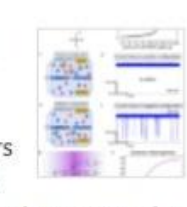


The authors present a super-bound state acoustic harvester that outperforms state-of-the-art acoustic energy harvesting systems.

Felix Kronowetter, Anton Melnikov & Steffen Marburg

Article
13 April 2025 | Open Access

Charge symmetry breaking in neutral polyzwitterions



Response of polar and neutral monomers in macromolecules to an electric field in their crowded aqueous solutions remains as an unchartered area of research. Here the authors investigate single-molecule electrophoresis of a couple of neutral polyzwitterions which have charge-neutrality with strong acidic group and permanent positive charge within their repeat units, and show that their charge-neutrality is broken which is attributed to gradients in the local dielectric constant.

Yeseul Lee & Murugappan Muthukumar

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Article
13 April 2025 | Open Access

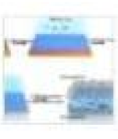
Exceptional point and hysteresis trajectories in cold Rydberg atomic gases

Long-range interactions in many-body quantum systems may induce dissipation channels described by non-Hermitian dynamics. Here, the authors report the observation of higher-order exceptional points, a hallmark of non-Hermitian physics, in a Rydberg atom gas. This enables design of quantum dynamics around these points, providing insight into phase transitions.

Jun Zhang, En-Ze Li & Bao-Sen Shi

Article
13 April 2025 | Open Access

Principles for fabricating moisture barrier films via stacked Janus graphene layers



The authors fabricate graphene barrier films with low transmission ($5 \cdot 10^{-5}$ g·m^{-2}·d^{-1}) using reactive ion etching and oxygen plasma treatment, highlighting the importance of surface modification and intercalation in enhancing barrier performance.

Chaofan Zhou, Hongjie Gao & Li Lin

Article
13 April 2025 | Open Access

High-energy and long-life O3-type layered cathode material for sodium-ion batteries

O3-type layered oxides are promising for sodium-ion batteries but suffer from rapid capacity decay. Here, the authors demonstrate that a NaCaPO$_4$-derived gradient Ca^{2+}-doped reconstruction layer enhances stability by mitigating phase transition-induced lattice stress and homogenizing Na-ion distribution.

Xinghui Liang, Xiaosheng Song & Yang-Kook Sun

Article
13 April 2025 | Open Access

Modulating the covalency of Ru-O bonds by dynamic reconstruction for efficient acidic oxygen evolution

Long-term stability is a key challenge for ruthenium-based oxygen evolution reaction (OER) catalysts. Here, the authors present a RuO2/LiCoO2 catalyst with dynamic Li dissolution, which weakens the covalency of the Ru-O bond to prevent the lattice oxygen mechanism, thereby ensuring stable acidic OER.

Luqi Wang, Sung-Fu Hung & Shengjie Peng

Article
12 April 2025 | Open Access

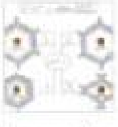
High-fidelity topochemical polymerization in single crystals, polycrystals, and solution aggregates

Topochemical polymerization (TCP) emerges as a leading approach for synthesizing single crystalline polymers, but the untapped potential of performing TCP in a liquid medium with solid-state structural fidelity presents unsolved challenges. Here, the authors reveal details of single-crystal-to-single-crystal transformation during the TCP of chiral azaquinodimethane monomers through in situ crystallographic analysis while spotlighting a rare metastable crystalline phase.

Chongqing Yang, Jianfang Liu & Yi Liu

Article
12 April 2025 | Open Access

Multicomponent one-pot construction of benzo[f]quinoline-linked covalent organic frameworks for H$_2$O$_2$ photosynthesis



In this work, Dong and coworkers report a set of benzo[f]quinoline-linked covalent organic frameworks via a one-pot three-component [4 + 2] cyclic condensation reaction which are used as photocatalysts for H$_2$O$_2$ production in pure water.

Ke-Hui Xie, Guang-Bo Wang & Yu-Bin Dong

Article
12 April 2025 | Open Access

Metal-organic framework glass stabilizes high-voltage cathodes for efficient lithium-metal batteries

Li-ion batteries based on high-voltage Ni-rich layered oxides are hampered by stability and ion diffusion issues. Here, authors develop a metal-organic-framework liquid-infusion technique to create a rigid glass layer on the oxide particles, improving both Li$^+$ diffusion and battery stability.

Lishun Bai, Yan Xu & Haoshen Zhou

Article
12 April 2025 | Open Access

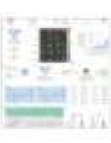
Generation of field-reversed configurations via neutral beam injection

The field-reversal configuration (FRC) represents a fusion device concept capable of high power density with a compact geometry. Here, the authors report on the generation and sustainment of a FRC by means of neutral beam injection in the C-2W machine at TAE technologies. This contributes towards establishing FRC as an alternative economic fusion device.

T. Roche, S. Dettrick & M. W. Binderbauer

Article
12 April 2025 | Open Access

Nanoparticle delivery of a prodrug-activating bacterial enzyme leads to anti-tumor responses



Lipid nanoparticles (LNPs) delivering mRNA after intratumoral administration could be a promising cancer treatment strategy. Here this group reports the intratumoral delivery of mRNA with LNPs inducing the expression of purine nucleoside phosphorylase and inhibiting the progression of head and neck squamous cell carcinoma in vivo.

Sebastian G. Huayamares, Liming Lian & James E. Dahlman

Article
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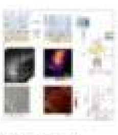
Plasmonic in-situ imaging of zeta potential distributions at electrochemical interfaces of 2D materials in water



Understanding the electrical double layer at solid-liquid interfaces is crucial for various technologies. Here, the authors present an optical method for direct visualization and quantification of the zeta potential at 2D material interfaces.

Xiaona Zhao, Xiao-Li Zhou & Xian-Wei Liu

Article
11 April 2025 | Open Access

Detection of single-mode thermal microwave photons using an underdamped Josephson junction

It is shown that 14 GHz photons, thermally emitted from a copper cavity, can be detected by a Josephson junction with 45% efficiency and 0.1 Hz dark count rate. Demonstrated super-Poissonian photon statistics is a signature of thermal light and a hallmark of quantum chaos.

A. L. Pankratov, A. V. Gordeeva & L. S. Kuzmin

Article
11 April 2025 | Open Access

Learning-based 3D human kinematics estimation using behavioral constraints from activity classification

Inertial measurement units offer a cost-effective, portable alternative to lab-based systems for measuring human motion. Here, the authors predict human motion using inertial measurement units combined with machine learning, leveraging limited movement patterns and reduced motion variability during specific activities.

Daekyum Kim, Yichu Jin & Conor J. Walsh

Article
11 April 2025 | Open Access

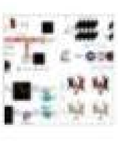
Insights into lattice oxygen and strains of oxide-derived copper for ammonia electrosynthesis from nitrate

Electrocatalytic nitrate reduction is promising for NH$_3$ synthesis, but it suffers from low NH$_3$ efficiency. Here, the authors report oxide-derived copper with residual lattice oxygen and lattice strains to enhance NH$_3$ synthesis via promoting active hydrogen supply and nitrite conversion.

Qinyue Wu, Xinfei Fan & Yanming Liu

Article
11 April 2025 | Open Access

In situ fully vectorial tomography and pupil function retrieval of tightly focused fields



Tightly focused optical fields are essential in nano-optics, but lack tools for accurate yet efficient characterization. Here, the authors develop an in situ method to reconstruct the fully vectorial information of tightly focused fields in 3D space.

Xin Liu, Shijie Tu & Xiang Hao

Article
11 April 2025 | Open Access

Synergistic immobilization of ions in mixed tin-lead and all-perovskite tandem solar cells

The introduction of ethylenediammonium diiodide reduces defects but also leads to severe hysteresis caused by excessive mobilized ions. Here, authors employ hydrazine monohydrochloride as a bulk passivator to mitigate such hysteresis, achieving maximum efficiency of 28.55% for tandem solar cells.

Yuhui Liu, Tianshu Ma & Xiaofeng Li

Article
11 April 2025 | Open Access

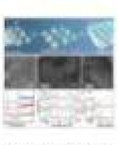
Synthesis of aromatic amides from lignin and its derivatives

Benzamides are widely found structural motifs, but their syntheses are largely derived from petrochemical-based feedstocks. Here the authors present the concept of "lignin to amides" with a one-pot, multi-step oxidation process utilizing molecular oxygen and a 3d-metal catalyst with highly dispersed and stable cobalt species (Co-SACs), supported on nitrogen-doped carbon in water as solvent.

Zhuang Ma, Zupeng Chen & Matthias Beller

Article
11 April 2025 | Open Access

Stable Ni(II) sites in Prussian blue analogue for selective, ampere-level ethylene glycol electrooxidation



Hydrogen production coupled with electrochemical oxidation of organic nucleophiles is often limited by catalyst's reconstruction at the anode. Here, the authors developed the stable Ni(II) active sites in Prussian Blue analogue for fast, selective ethylene glycol electrooxidation and constructed an effective coupled electrochemical hydrogen production flow cell.

Ji Kai Liu, Mengde Kang & Hua Gui Yang

Article
11 April 2025 | Open Access

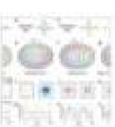
Direct nanopatterning of complex 3D surfaces and self-aligned superlattices via molecular-beam holographic lithography

Conventional lithography methods involve the transfer of patterns through resist templating. Here, the authors explore a concept based on the Moiré interference of molecular beams to directly write complex 3D surfaces and self-aligned superlattices.

Shuangshuang Zeng, Tian Tian & Chih-Jen Shih

Article
11 April 2025 | Open Access

Magnetic skyrmionic structures with variable topological charges in engineered Dzyaloshinskii-Moriya interaction systems



The authors experimentally realize the control of the topological charge of magnetic skyrmionic structures at room temperature in a Dzyaloshinskii-Moriya interaction (DMI) platform with spatially alternating signs. By modifying the DMI energy landscape through chemisorbed oxygen, a magnetic topological transition is realized.

Heng Niu, Han Gyu Yoon & Gong Chen

Article
11 April 2025 | Open Access

Low pressure amide hydrogenation enabled by magnetocatalysis

Due to their stability, reduction of amides typically requires harsh conditions or strong reductants. Here the authors report a method for amide reduction with molecular hydrogen under mild conditions by use of magnetocatalysis.

Sheng-Hsiang Lin, Sihana Ahmedi & Alexis Bordet

Article
11 April 2025 | Open Access

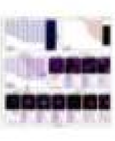
Genetic modulation of rare earth nanoparticle biotransformation shapes biological outcomes

Here the authors show that the biological fate of rare earth nanoparticles can be genetically controlled by SMPD1 in cells, offering insights for the prevention or treatment of rare earth associated hazard effects, such as inflammation and pneumoconiosis.

Mingming Tian, Di Wu & Xiaowei Zhang

Article
11 April 2025 | Open Access

Differential interactions determine anisotropies at interfaces of RNA-based biomolecular condensates



Experiments and computations show that the organization and dynamics of molecules within and at interfaces of biomolecular condensates are governed by differential interaction strengths leading to the classification of adsorbents versus scaffolds.

Nadia A. Erkamp, Mina Farag & Rohit V. Pappu

Article
10 April 2025 | Open Access

Enhancing catalytic durability in alkaline oxygen evolution reaction through squaric acid anion intercalation

The local acidic interfacial environment limits oxygen evolution at high current densities. Here, the authors report that intercalating squaric acid anions into NiFe-based electrocatalysts stabilizes the interface, inhibiting acidification and achieving stability for 700 h at 3.0 A cm^{-2}.

Ruoyao Fan, Shanshan Lu & Bin Zhang

Article
10 April 2025 | Open Access

Customizable wave tailoring nonlinear materials enabled by bilevel inverse design

Nonlinearity can profoundly alter signals. Here, authors introduce an inverse material design method to achieve targeted nonlinear dynamic responses. Applied to impact mitigation and pulse shaping, this approach reveals both strong sensitivity to constituent nonlinearity and the potential for high-performance designs.

Brianna MacNider, Haning Xiu & Nicholas Boechler

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