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Featured

Article
28 October 2025 | Open Access

Charge transfer governed interlayer magnetic coupling and symmetry breaking in a van der Waals magnet

CrSBr is an air-stable van der Waals semiconducting layered antiferromagnet, holding the promise for a variety of spintronic applications. However, like all antiferromagnets, readout and control of the magnetic structures are challenging. Here, using a graphene gate on trilayer CrSBr, Hong, Sun, and coauthors succeed in full discrimination of otherwise degenerate magnetic states and electrical control of magnetic transitions.

Canyu Hong, Zeyuan Sun & Shiwei Wu

Article
28 October 2025 | Open Access

Experimental realization of temporal refraction and reflection in elastic beams

The authors experimentally demonstrate the refraction and reflection of flexural waves at a temporal boundary in an elastic beam with time-varying stiffness, achieved through piezoelectric patches and circuit-driven modulation. The findings validate the temporal Snell's law and Fresnel equations, enabling precise control over wave amplitude and frequency.

Shaoyun Wang, Nan Shao & Guoliang Huang

Article
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Giant shot noise in superconductor/ferromagnet junctions with orbital-symmetry- controlled spin-orbit coupling

The authors observe shot noise orders of magnitude greater than expected in superconductor/insulator/ferromagnet (V/MgO/Fe) junctions. They argue that the origin involves orbital-symmetry-controlled superconducting proximity effect and spin-triplet superconductivity in the Fe.

César González-Ruano, Chenghao Shen & Farkhad G. Aliev

Article
28 October 2025 | Open Access

Microenvironment engineering unveils surface methoxy species origination in zeolite-catalyzed methanol chemistry under mild conditions

Deciphering the formation sequence of surface methoxy species (SMS) and dimethyl ether (DME) in zeolite-catalyzed methanol reactions remains a challenge. Here, the authors tackle this issue by employing a microenvironment design strategy to steer reaction pathways within zeolite channels, enabling SMS formation from DME decomposition catalyzed by Brønsted acids at 363 K.

Fengqing Liu, Xianfeng Yi & Anmin Zheng

Article
28 October 2025 | Open Access

Defect engineering in BaSnO$_3$ and SrSnO$_3$ thin films through nanoscale substrate patterning

A method of nanometre-level patterning of high-density extended 1D and 2D defects in thin films of perovskite oxides is developed.

Supriya Ghosh, Fengdeng Liu & K. Andre Mkhoyan

Article
28 October 2025 | Open Access

Low-dimensional templates and delayed crystallization for high-quality tin-based perovskite films and high-performance transistors

Wu et al. report the sequential crystallization in quasi-2D tin-based perovskites, achieved by preferential formation of low-dimensional templates and delayed 3D growth, yielding vertically oriented and low-defect films for field-effect transistors with high mobility, negligible hysteresis, and improved stability.

Yanqiu Wu, Shuzhang Yang & Wenwu Li

Article
28 October 2025 | Open Access

Link between cascade phenomenon and correlated Chern insulators in magic-angle twisted bilayer graphene

The authors study magic angle twisted bilayer graphene using Rydberg exciton sensing spectroscopy, via a monolayer WSe2 sensor layer. At high magnetic field, they observe correlated Chern insulators, which they show are linked with zero-field cascade features in the electronic compressibility.

Qianying Hu, Shu Liang & Yang Xu

Article
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Theory of topological superconductivity and antiferromagnetic correlated insulators in twisted bilayer WSe$_2$

Recently, unconventional superconductivity was discovered in twisted-bilayer WSe$_2$. Here, the authors' theoretical analysis reveals that the ground state is a topological superconductor with Chern number C = ± 2 and dominant inter-valley pairing of \({d}_{xy}\pm i{d}_{{x}^{2}-{y}^{2}}\) symmetry.

Chuyi Tuo, Ming-Rui Li & Hong Yao

Article
28 October 2025 | Open Access

Interfacial ferroelectricity unlocks stable formamidinium-based perovskites

Achieving long-term phase-stabilized formamidinium (FA)-based perovskites remains challenging. Here, authors integrate ferroelectric CsMnBr3 nanocrystals into FA-based perovskites for ferroelectric field-mediated structural regulation, achieving maximum efficiency of 26.62% for stable solar cells.

Yong Wang, Wenbin Han & Deren Yang

Article
28 October 2025 | Open Access

Large-scale crossbar arrays based on three-terminal MoS$_2$ memtransistors

Three-terminal memtransistors can improve the neuromorphic performance of conventional two-terminal memristors. Here, the authors report the fabrication of high-yield large-scale crossbar array architectures incorporating up to 2,048 2D MoS$_2$ memtransistors per array, showing low-power memory and image recognition applications.

Thomas F. Schranghamer, Andrew Pannone & Saptarshi Das

Article
28 October 2025 | Open Access

Yttrium oxide engineered substrate enables improved durability for perovskite solar cells

The impact of fluorine doped tin oxide (FTO) on device longevity has been overlooked. Here, the authors employ thermal evaporated yttrium oxide to strengthen structural stability of FTO, achieving maximum efficiency of 26.48% and 28.47% in regular and all-perovskite tandem structures, respectively.

Haibing Wang, Yansong Ge & Guojia Fang

Article
28 October 2025 | Open Access

Nanoscale soft interaction-engineered perovskite heterojunctions for highly efficient and reproducible solar cells

Conventional design of perovskite heterojunctions face challenges in precisely controlling interfacial phase purity at nanoscale. Here, the authors introduce dimethyl sulfide as a soft Lewis base additive in organic cation solution, achieving certified efficiency of 26.48% in stable solar cells.

Bo Li, Danpeng Gao & Zonglong Zhu

Article
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Liquid metal interface enables glassy MOF membranes with defect-mediated CO$_2$ transport

Glassy MOF membranes fabricated via a liquid-metal interface enable defect-mediated CO$_2$ transport, revealing how interfacial control and defect engineering combine to produce high-performance porous membranes.

Xiaoheng Jin, Xing Wu & Zongli Xie

Article
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A dynamic biointerface in mussels mediated by a mechanoresponsive intermediate filament-based biopolymer

Mussels produce a dynamic bio-interface between their living tissue and their non-living byssus attachment, relevant for design of implant devices. Here, authors discover a mechanoresponsive protein that may mediate mechanosensing at the interface.

Lucia Youssef, Jenaes Sivasundarampillai & Matthew J. Harrington

Article
28 October 2025 | Open Access

Scalable transition metal dichalcogenide memtransistor arrays with Schottky-barrier control for energy-efficient artificial neural networks

2D memtransistors are promising candidates for energy-efficient neuromorphic computing, but their scalability remains challenging. Here, the authors report the fabrication of 2D MoS$_2$ memtransistor arrays with controllable Schottky barrier, demonstrating device-to-device variation <6.8% and high performance for image recognition tasks.

Xiangyu Hou, Wei Zhang & Wei Chen

Article
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Multi-lens ultrasound arrays enable large scale three-dimensional micro-vascularization characterization over whole organs

Whole-organ blood flow can now be mapped in three dimensions at micrometric resolution using ultrasound multi-lens matrix arrays, demonstrated here in the heart, kidney, and liver of large animals in vivo.

Nabil Haidour, Hugues Favre & Clement Papadacci

Article
28 October 2025 | Open Access

Unconventional bias-dependent tunneling magnetoresistance in van der Waals ferromagnetic/semiconductor heterojunctions

The combination of a diverse selection of magnetic and semiconducting constituent materials makes van der Waals heterojunctions ideal for exploring effects associated with tunnelling magnetoresistance. Here, Zhu, Wen, Zhu, Cui, and coauthors report on a unusual bias dependence of tunnelling magnetoresistance, that they explain via a planar dependent tunnelling model.

Wenkai Zhu, Hui Wen & Kaiyou Wang

Article
28 October 2025 | Open Access

Stress-hardening behaviour of biofilm streamers

Bacterial biofilms can form as streamers - filamentous structures suspended in fluids that withstand intense hydrodynamic stresses - enabling colonisation of flow-exposed environments such as medical devices and filters. The authors demonstrate that streamers exhibit stress hardening driven by extracellular DNA and modulated by RNA, providing a physical mechanism for both short- and long-term mechanical adaptation.

Giovanni Savorana, Tommaso Redaelli & Eleonora Secchi

Article
28 October 2025 | Open Access

Three rate-determining protein roles in photosynthetic O$_2$-evolution addressed by time-resolved experiments on genetically modified photosystems

Combining time-resolved IR spectroscopy, activation energy analyses, and computations, authors provide mechanistic insight into genetically altered reaction kinetics of light-driven oxygen evolution in photosystem II.

Sarah M. Mäusle, Gianluca Parisse & Holger Dau

Article
27 October 2025 | Open Access

Enhancing radiostrontium uptake by a layered titanate perovskite via sustainable electrochemically switched ion exchange

Green and sustainable ^{90}Sr uptake is urgently needed for radionuclides remediation. Here the authors propose an efficient strategy based on the electrochemically switched ion exchange (ESIX) method to enhance ^{90}Sr uptake using the electroactive ion exchange material.

Zhi-Hua Chen, Feng-Hua Ding & Zhang Lin

Article
27 October 2025 | Open Access

Real-space observation of a time-reversal invariant topological state in twisted bilayer InSe

Time-reversal invariant topological states in twisted 2D semiconductors have been previously reported, but their direct visualization in real space has remained elusive. Here, the authors report scanning tunnelling microscopy/spectroscopy measurements of twisted bilayer InSe, showing the formation of magnetic-field sensitive topological edge modes at the moiré domain boundary.

Dacheng Tian, Shengdan Tao & Lan Chen

Article
27 October 2025 | Open Access

The successful impossible radical ring-opening copolymerization of thionolactones and methacrylates via an auxiliary third comonomer

Polymethacrylate derivatives are widely used in industry but precise incorporation of degradable thioester bonds in polymethacrylates to achieve degradability remains challenging. Here the authors show that a thionolactone can be inserted into poly(methyl methacrylate) using an auxiliary third comonomer.

Bastien Luzel, Ignatii Efimov & Yohann Guillaneuf

Article
27 October 2025 | Open Access

Chiral two-dimensional conjugated metal-organic frameworks with high spin polarization

Two-dimensional conjugated metal-organic frameworks (2D c-MOFs) are emerging candidates for organic 2D crystal materials, but the precise implantation of chirality has yet to be demonstrated. Here, the authors report a side chain-induced chirality amplification strategy to achieve tunable chiral expression in 2D c-MOFs.

Shiyi Feng, Yang Lu & Xinliang Feng

Article
27 October 2025 | Open Access

Robust zwitterionic hydrogels enabled by consolidated supramolecular networks and spatially hierarchical structures

Zwitterionic hydrogels have potential in a range of applications due to favourable properties, but often mechanical properties are not suitable. Here, the authors report a hydrogel with an entangled supramolecular network for hierarchical networks, for zwitterionic materials with favourable material properties.

Xingkui Guo, Lijie Zhang & Wei Zhai

Article
27 October 2025 | Open Access

Fe-(μ-O)-Zn dual-atom boosting C-C coupling for direct oxidation of methane to acetic acid using O$_2$

Direct methane oxidation to C2+ with O$_2$ is impeded by tough C–H activation and uncontrolled coupling. Here, Fe-(μ-O)-Zn dual-atom sites on ZSM-5 enable efficient photocatalytic acetic acid production at ambient temperature and pressure.

Baiyang Yu, Wenlong Li & Yang Lou

Article
27 October 2025 | Open Access

Dynamic radical recombination enabling stereodivergent construction of spirocycles with nonadjacent stereocenters

Chiral spirocyclic scaffolds have garnered significant attention in drug discovery and chiral ligand development due to their rigid structures and potential bioactive properties. Herein, the authors report a dynamic radical recombination strategy that enables cobalt-hydride-catalyzed ligand-controlled stereodivergent olefin hydroalkylation, delivering a series of spirocyclic compounds bearing 1,3-non-adjacent stereocenters.

Zheng Sun, Jichao Huang & Zhihui Shao

Article
27 October 2025 | Open Access

Visualizing alkali metal aggregation-induced coordination in CO$_2$ activation on copper

Using scanning tunneling microscopy and qPlus based non-contact atomic force microscopy, this work directly visualized the aggregation of specific number of alkali metals in promoting the activation and reaction of CO$_2$ on copper surfaces.

Wenyu Sun, Pu Yang & Jing Guo

Article
27 October 2025 | Open Access

Barcode-free hit discovery from massive libraries enabled by automated small molecule structure annotation

Affinity-selection platforms are powerful tools in early drug discovery, but current technologies such as DNA-encoded libraries (DELs) are limited by synthesis complexity and incompatibility with nucleic acid binding targets. Here, the authors present a barcode-free self-encoded library (SEL) platform that enables direct screening of over half a million small molecules in a single experiment.

Edith van der Nol, Nils Alexander Haupt & Sebastian Pomplun

Article
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Assembly of dynamic helical β-peptides with switchable handedness into multiple types of metal-peptide frameworks

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Metal-directed assemblies of helical peptides have emerged as chiral biomimetic materials, but examples of dynamic helical peptides are rare, despite their ability to adopt multiple conformations. Here the authors report the coordination-driven assembly of a dynamic helical β-pentapeptide into metal peptide frameworks with silver ions.

Ingyu Han, Ha-Jin Lee & Soo Hyuk Choi

Article

27 October 2025 | Open Access

Signatures of quantum spin liquid state and unconventional transport in thin film TbInO$_3$

The thin film realization of quantum spin liquid candidates has remined elusive. Here, the authors synthesize thin films of the quantum spin liquid candidate TbInO3 and characterize the magnetic and electronic properties.

Johanna Nordlander, Margaret A. Anderson & Julia A. Mundy

Article

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Temporal fingerprints for identity matching across fully encrypted domains

Here, the authors propose a scalable framework for cross-domain identity matching based on bursty dynamics, revealing how coordinated actions propagate across networks.

Shahar Somin, Keeley Erhardt & Alex 'Sandy' Pentland

Article

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Ultra-high entropy rare earth phosphate against environmental corrosion

Using ultra-high-entropy rare-earth phosphates, the authors show that single-phase solids with high compositional complexity and larger rare-earth ionic radii slow reaction kinetics and increase chemical inertness, leading to improved high-temperature corrosion resistance.

Fuhao Cheng, Donald B. Dingwell & Wenjia Song

Article

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Metallocene-anchor inducing oriented MOF membrane for helium separation

The authors present a ligand-anchoring strategy for fabricating oriented MOF membranes, enabling precise He/CH$_4$ separation and concentrating He from 0.3% to 99.9%. This approach highlights the design of efficient MOF-based separation materials.

Ju Bai, Luqi Xiao & Suojiang Zhang

Article

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Achieving improved mechanical performance in aluminum matrix composites with rebar-reinforced concrete-inspired structures

Inspired by rebar steel-reinforced concrete (RC) structures used in buildings, aluminum matrix composites are designed which achieve nearly 1 GPa in yield strength and specific strength of (235 kN·m/kg) at 400 °C.

Chenwei Shao, Huicong Chen & Yu Zou

Article

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Confinement-enhanced valorization of contaminants in electrified hydrogenation membranes for water purification

The study identifies an optimal pore size of ~7 μm in electrified membranes for contaminant valorization. This size maximizes reaction efficiency by balancing mass transfer and current distribution. The finding provides a key design principle for sustainable water treatment technologies.

Yuyang Kang, Zhenao Gu & Jiuhui Qu

Article

27 October 2025 | Open Access

Proximity-induced nodal metal in an extremely underdoped CuO$_2$ plane in triple-layer cuprates

The authors present ARPES measurements on the triple-layer cuprate superconductor Bi$_2$Sr$_2$Ca$_2$Cu$_3$O$_{10+\delta}$. They find that, although the doping level of the inner CuO$_2$ plane is extremely low in under-doped samples, the d-wave superconducting gap is enhanced at the antinode and persists well above T_c without a Fermi arc, indicating a "nodal metal".

Shin-ichiro Ideta, Shintaro Adachi & Atsushi Fujimori

Article

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Conductive binary Li borate glass coating for improved Ni-rich positive electrode in sulfide-based all-solid-state Li batteries

Ni-rich cathodes in sulfide-based all-solid-state batteries suffer from severe interfacial degradation. Here, authors apply an ultrathin conductive lithium borate glass coating via a simple dry process, which enables improved long-term cycling, a high areal capacity, and high-energy pouch cells.

Jiayao Luo, Bangjun Guo & Xiaodong Zhuang

Article

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Multi-view deep learning framework for the detection of chest X-rays compatible with pediatric pulmonary tuberculosis

In this work, authors present an AI framework to detect pediatric tuberculosis by using both frontal and lateral chest X-rays, showing robust performance across several age groups and settings.

Daniel Capellán-Martín, Juan J. Gómez-Valverde & María J. Ledesma-Carbayo

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Article

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Resolution limit of the eye – how many pixels can we see?

This work determines the maximum display resolution that the human eye can discriminate. The limit was determined for achromatic and chromatic vision, for both the fovea and periphery.

Maliha Ashraf, Alexandre Chapiro & Rafał K. Mantiuk

Article

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Unsteady flows uncover the limits of the stress-optic law

Flow birefringence in complex fluids has long been viewed as a noninvasive probe for stress fields based on the stress-optic law. Experiments reveal that this law fails in unsteady flows, with birefringence only reflecting stress at large Deborah numbers, leading to a new framework that separates microscopic and macroscopic contributions.

Daisuke Noto, Kohei Ohie & Yuji Tasaka

Article

24 October 2025 | Open Access

Photochemical rearrangement of isonitriles via energy transfer catalysis

Functional group interconversion, a pivotal synthetic technique for precise editing of molecular building blocks, is rare when facilitated by energy transfer catalysis. Herein, the authors report two instances of photochemical rearrangement of isonitriles, facilitated by energy transfer catalysis under visible light.

Qi-Xin Dong, Yi-Hong Ke & Huan-Ming Huang

Article

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Lowering the Cu-O bond energy in CuO nanocatalysts enhances the efficiency of NH$_3$ oxidation

Tuning the electronic properties of nanocatalysts by doping them with uniformly dispersed hetero-metal atoms is an effective way to improve catalytic performance. Here, the authors show that weakening the Cu–O bond energy in CuO nanocatalysts boosts the efficiency of NH$_3$ oxidation.

Lu Chen, Xuze Guan & Feng Ryan Wang

Article

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Phase-probability shaping for speckle-free holographic lithography

The authors report lensless holography lithography with diffraction-limited resolution by proposing a phase-probability shaping mechanism to suppress speckle noise efficiently.

Dong Zhao, Weiwei Fu & Kun Huang

Article

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Matrix-based imaging through dynamic scattering

A matrix-based imaging method enables high-resolution imaging through dynamic scattering by exploiting a mathematical equivalence to static media, allowing state-of-the-art methods to recover images from a few frames in coherent and incoherent setups.

Elad Sunray, Gil Weinberg & Ori Katz

Article

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27%-efficiency silicon heterojunction cell with 98.6% cell-to-module ratio driving new momentum towards the 29.4% limit

Achieving efficiency by approaching the theoretical limit in silicon heterojunction solar cells remains challenging. Here, the authors fabricate devices using rear-side polishing and progressive RF/VHF PECVD film deposition schemes for doping layers, realizing a certified cell efficiency of 27.0%.

Zhigang Xie, Haijiang Lu & Jifan Gao

Article

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Charge redistribution dynamics in chalcogenide-stabilized cuprous electrocatalysts unleash ampere-scale partial current toward formate production

Electrochemical CO$_2$ reduction to formate offers a sustainable route but has been difficult to achieve selectively on transition metals. Here, the authors show that chalcogenide-stabilized Cu$^+$, via charge redistribution, enables near-complete formate production with industrially relevant efficiency.

Feng-Ze Tian, Wen-Jui Chang & Hao Ming Chen

Article

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The northeast materials database for magnetic materials

A major bottleneck in the use of machine learning in materials discovery is the need for high quality material datasets for training. Here, Itani and coauthors introduce NEMAD, the northeast materials database, collated from the scientific corpus of articles using Large Language Model to extract the relevant magnetic, crystallographic and chemical data.

Suman Itani, Yibo Zhang & Jiadong Zang

Article

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Periodically-modulated unipolar and bipolar orders in nematic fluids towards miniaturized nonlinear vectorial optics

Complex polar topological configurations underpin exotic phases in condensed-matter physics, but controlled design of magnetically and electrically polar textures has remained a major challenge. Authors report a new mesophase with unipolar and bipolar orders that enables defect-free, large-scale polar patterning, demonstrated by generating second-harmonic vector beams in a single micrometer-thin liquid crystal device.

Guang-Yang Zhang, Ling-Ling Ma & Yan-Qing Lu

Article

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Sub-10 nm upconversion nanocrystals for long-term single-particle tracking

This study presents ultrasmall, bright lanthanide-doped upconversion nanoparticles that overcome surface quenching, enabling high spatiotemporal resolution tracking of membrane proteins with exceptional photostability.

Xiaochen Qiu, Daoming Guan & Qian Liu

Article

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Insight into the effects of gamma radiation on MLCCs: from in situ capacitance experiments to physical mechanisms

This investigation pioneers in situ capacitance experimentation in BaTiO$_3$-based multilayer ceramic capacitors, and reports three radiation response mechanisms: total ionizing dose effect, enhanced low dose rate sensitivity effect, and self-recovery effect.

Ping Yang, Ting Zheng & Chao Zeng

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Article
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Modeling macroscopic brain dynamics with brain-inspired computing architecture

Modeling macroscopic brain dynamics is essential but limited by the slow and intensive process of fitting models to empirical data. Here, authors introduce a dynamics-aware quantization framework and hierarchical parallelism mapping strategies to enable accurate low-precision simulations on brain-inspired chips and GPUs.

Zhong Zheng, Jing Wei & Lei Deng

Article
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Particle decoration enables solution-processed perovskite integration with fully-textured silicon for efficient tandem solar cells

Achieving complete coverage of 2-4 µm pyramids on industrial fully-textured silicon with solution processed perovskite film remains challenging. Here, authors spray-coat alumina particles on silicon for near-conformal deposition of perovskites, achieving efficiency of 32.74% for tandem solar cells.

Naihe Liu, Gao Zhang & Bo Chen

Article
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Targeted high-resolution sensing of volatile organic compounds by covalent nanopore detection

Volatile organic compounds are important analytes in medical diagnostics, with aldehydes forming a characteristic subclass. Here, the authors report that covalent nanopore sensing enables the targeted detection of aldehydes in mixtures through reversible thiol–aldehyde chemistry, offering a route to portable and low-cost analysis.

Lauren E. McGivern, Zhong Hui Lim & Yujia Qing

Article
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Real-time self-supervised denoising for high-speed fluorescence neural imaging

Noise in high-speed fluorescence imaging limits real-time analysis of neural dynamics. We present FAST, a lightweight deep-learning framework that leverages spatial-temporal redundancy for calcium, voltage, and volumetric imaging, enabling real-time denoising at >1000 fps.

Yiqun Wang, Yuanjie Gu & Biqin Dong

Article
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Explore brain-inspired machine intelligence for connecting dots on graphs through holographic blueprint of oscillatory synchronization

Neural coupling is a challenge in understanding both brain function and advancing machine intelligence. Here, the authors introduce HoloBrain and HoloGraph, a brain-inspired framework that models oscillatory synchronization to overcome limitations of graph neural networks and enable more efficient, robust learning.

Tingting Dan, Jiaqi Ding & Guorong Wu

Article
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Organocatalytic enantioselective [$2\pi + 2\sigma$] cycloaddition reactions of bicyclo[1.1.0]butanes with α,β-unsaturated aldehydes

Bicyclo[2.1.1]hexanes (BCHs), three-dimensional benzene bioisosteres characterized by high sp3-carbon content, hold great promise for diverse applications in medicinal chemistry. Here, authors report a secondary amine–catalyzed asymmetric [2π + 2σ] cycloaddition of bicyclo[1.1.0]butanes (BCBs) with α,β-unsaturated aldehydes.

Yi-Xiang Geng, Teng-Fei Xiao & Peng-Fei Xu

Article
23 October 2025 | Open Access

Copper-catalyzed enantioselective synthesis of γ-butenolides via radical diversification of allenoic acid

Chiral γ-butenolides, which are widely prevalent in natural products and pharmaceuticals, necessitate synthetic methods that precisely control both stereochemistry and substituent diversity. Here, the authors report a Cu/PyBim-catalyzed asymmetric lactonization of 2,3-allenoic acids initiated by sulfonyl or phosphonyl radicals.

Bingxu Han, Zaicheng Nie & Hongli Bao

Article
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DNA computing function switching by programming base stacking interactions with minimal molecular architecture changes

DNA computing systems face challenges in switching functions due to complex molecular redesigns. Here, the authors introduce a base Stacking-Mediated Allostery (SMALL) strategy enabling efficient function switching with minimal architecture changes (1-2 nucleotides), implemented across diverse logic operations and cellular gene regulation patterns.

Yongpeng Zhang, Bozhao Li & Cheng Zhang

Article
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Water adlayers bridging metal spillover to boost catalytic activity

While hydrogen spillover has been widely investigated in heterogeneous catalysis, the migration of metal species via a similar mechanism remains poorly understood. Here, the authors reveal a metal-species spillover process enabled by water adlayers on support surfaces.

Yamei Fan, Rongtan Li & Qiang Fu

Article
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Temperature-dependent dynamic disproportionation in $LiNiO_2$

A dynamic interconversion of three nickel states in lithium nickel oxide is demonstrated using evidence from x-ray spectroscopic data and first-principles calculations, which explains many physical properties of this and similar materials.

Andrey D. Poletayev, Robert J. Green & M. Saiful Islam

Article
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Photocatalytic non-oxidative dehydrogenation of ethane to ethene with near unit selectivity

Non-oxidative alkene dehydrogenation is hindered by side reactions like cracking, iso- or polymerization, or alkyne formation. Here the authors report a Pd/TiO2 photocatalyst decorated with Ni single sites for selective ethane to ethylene production under simulated solar light conditions with high yields.

Xiaoyu Sui, Jiwu Zhao & Jinlin Long

Article
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Selecting fitted models under epistemic uncertainty using a stochastic process on quantile functions

An enduring challenge with mathematical modelling is selecting between multiple models with similar prediction accuracy. Here, authors propose a method for estimating how accuracy is maintained across replication experiments, thus allowing for more robust comparisons between models fitted to data.

Alexandre René & André Longtin

Article
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Programmable molecular dethreading towards tunable drug release

Pseudorotaxane dethreading offers a means to regulate motion in artificial molecular machines but achieving predictable and programmable control over dethreading kinetics remains challenging. Here, the authors report systematic modulation of dethreading behaviour through component engineering of a pseudorotaxane platform.

Shen Sheng, Yuanhe Li & Chong Tian

Article
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A digital twin framework for urban parking management and mobility forecasting

Here, authors present a Digital Twin framework for urban parking and mobility in Caserta. By integrating distributed sensor data with machine learning and generative AI, the system enables real-time monitoring, forecasting, and scenario simulation to support smarter urban management.

Francesco Piccialli, Sara Amitrano & Marzia Canzaniello

Article
23 October 2025 | Open Access

Formal pyridine *meta*-azidation and its application for the synthesis of diazepines, ring-fused δ-carbolines and 1,2,3-triazolylpyridines

Late-stage peripheral functionalization and structural editing of nitrogen-containing heterocycles have garnered increasing attention due to their potential for the preparation of diversifying drug-like libraries. Herein, the authors report a peripheral regioselective meta-azidation of pyridines through dearomatized oxazino pyridine intermediates, and a subsequent molecular editing step via a photo-mediated singlet nitrene insertion process.

Shu-Min Guo, Pengwei Xu & Armido Studer

Article
23 October 2025 | Open Access

Polarity-dependent ferroelectric modulations in two-dimensional hybrid perovskite heterojunction transistors

The authors demonstrate a two-dimensional ferroelectric heterojunction transistor that exploits polarity-dependent transitions between ferroelectricity and charge trapping, enabling both memory and synaptic functions, and enhancing AI training efficiency.

Enlong Li, Weixin He & Wenwu Li

Article
23 October 2025 | Open Access

Flexible InGaAs/InAlAs avalanche photodiodes for short-wave infrared detection

The authors report flexibleInGaAs/InAlAs avalanche photodiodes, offering high responsivity, low dark current, and decentinternal gain in the SWIR range. Device performance remains stable under bending, supporting flexible sensing applications.

Jishen Zhang, Rui Shao & Xiao Gong

Article
23 October 2025 | Open Access

Observation of continuous time crystals and quasi-crystals in spin gases

The authors report on the observation of continuous time crystals of nuclear spins of 129Xe atoms within a Rb-Xe gaseous mixture in a magnetic feedback scheme. This unveils nontrivial role of magnetic fields and a new continuous time quasi-crystal phase.

Ying Huang, Tishuo Wang & Xinhua Peng

Article
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Chemical valorization of waste polyacrylonitrile polymers via shuttle catalysis

Acrylonitrile-based polymers are widely used in industrial and consumer settings, but their chemical recycling has largely been neglected, partly due to the potential release of harmful gases such as HCN and NOx. Herein, the authors report a catalytic process that enables valorization of the polymer's N- and C-content, without releasing harmful nitrogen gases.

Jarne Leinders, Thibaut Van Giel & Jesse Dallenes

Article
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Silk-enabled conformal intraventricular interfaces for minimally invasive neural recordings

The development of neural interfaces at subcortical nuclei surfaces is challenging. The authors present a flexible, minimally invasive neural interface that self-unfolds in cerebrospinal fluid to conform to periventricular surfaces, enabling long-term monitoring of deep brain disorders.

Jizhi Liang, Xiner Wang & Zhitao Zhou

Article
23 October 2025 | Open Access

A cortex-wide multimodal microscope for simultaneous Ca^{2+} and hemodynamic imaging in awake mice

Most optical tools for cortex-wide imaging are focused on either neuronal physiology or hemodynamics. Here, the authors present a cortex-wide multimodal imaging approach that facilitates simultaneous observation of neural activity and hemodynamics in awake mice.

Wei Qin, Tingting Li & Lei Xi

Article
23 October 2025 | Open Access

Injectable micropore-forming microgel scaffold for neural progenitor cells transplantation and vascularization after stroke

Stem cell therapy for stroke is limited by poor survival and integration. Here, the authors present an injectable microgel-matrix scaffold combining microporous microgels for cell delivery with interstitial spaces for vascular growth, improving neurological recovery in stroke models.

Huayan Wu, Ze Liu & Mian Wang

Article
22 October 2025 | Open Access

Decoding single-crystal lithium growth through solid electrolyte interphase omics

Understanding the impact of the solid electrolyte interphase (SEI) on lithium deposition is crucial for developing high-energy lithium metal batteries. Here, authors elucidate the multi-scale effects of the SEI on lithium deposition behavior based on the established SEI-omics framework.

Gongxun Lu, Zhiyuan Han & Guangmin Zhou

Article
22 October 2025 | Open Access

Hierarchical incremental learning deciphers molecular arrangements in multi-component materials

Understanding molecular arrangements in mechanistic studies of complex materials is critical but challenging. Here, the authors develop a hierarchical incremental learning protocol to uncover microscopic patterns, improving mechanistic insights obtained

Hanyin Zhang, Nan Lin & Haoyuan Li

Article
22 October 2025 | Open Access

Non-equilibrium demixing and dissolution of chiral coacervates via intrinsic catalysis

Constructing synthetic mimics of membraneless organelles using small molecules can contribute towards our understanding of active phase separation and their role in the chemical emergence of compartments. Herein, the authors develop a model of synthetic membraneless organelles as non-equilibrium droplet phase which are accessed via homotypic interactions between small activated molecule and short peptides.

Saurabh Gupta, Sangam Jha & Dibyendu Das

Article
22 October 2025 | Open Access

Liquid-matter relaxor ferroelectrics by design

Traditional relaxor ferroelectrics are rooted in crystalline systems, motivating exploration of their fluidic analogues through engineered polar nanoregions in dielectric nematic environments. Authors report a nematic relaxor ferroelectric that shows field-induced polarization and tunable energy landscapes, revealing stable high-temperature relaxor behavior and low-temperature field-induced ferroelectric transitions.

Xinxin Zhang, Yu Zou & Mingjun Huang

Article
22 October 2025 | Open Access

Dynamic activation catalysts for CO_2 hydrogenation

CO_2 hydrogenation on Cu/Al_2O_3 is limited by low activity. Herein, high-velocity gas collisions create transient distorted Cu sites, tripling CO_2 conversion, boosting methanol selectivity to 95 % and increasing the space-time-yield six times.

Zhewei Zhang, Jun Yao & Weiping Ding

Article
22 October 2025 | Open Access

Low-coordinated Co-Ru dual-atom enables ambient ammoxidation via unlocking competitive adsorption limitations

Creating renewable nitriles faces challenges like competitive adsorption and harsh conditions. Here a CoRu dual-atom catalyst enables efficient ammoxidation of aldehydes to nitriles under ambient conditions through synergistic adsorption.

Jialin Yang, Zhecheng Fang & Jie Fu

Article
22 October 2025 | Open Access

Reno-protective CT contrast nanoagent targets proximal tubular epithelium for kidney disease imaging and repair in a mouse model

Application of CT imaging to renal function evaluation is limited due to nonspecific distribution and nephrotoxicity of clinical iodinated contrast agents. Here the authors report the preclinical development of a kidney tubule-targeting and renoprotective CT contrast nanoagent (E-Au-Agent) for detection and repair of kidney injury.

Mingze Xu, Yuming Qi & Bujie Du

Article
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Tunable photon-recoil forces and negative torque at flat-top beam edges

Researchers present a photon-recoil manipulation method using polarization-modulated flat-top beams, enabling tunable, reversible nanoparticle transport, trapping, and torque—expanding capabilities beyond traditional optical tweezers.

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Fan Nan, Xiao Li & Yuebing Zheng

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Confining iodide migration with quantified barrier for durable perovskite solar cells

The blocking layer atop perovskite film cannot completely prevent ion movement due to trade-off with carrier transport. Here, authors develop a composite layer and use poly(N-vinylcarbazole) as the hole transport material, achieving certified steady-state efficiency of 25.7% for stable solar cells.

Hongcai Tang, Yangzi Shen & Qifeng Han

Article
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Efficient classical sampling from Gaussian boson sampling distributions on unweighted graphs

The authors propose Markov chain Monte Carlo algorithms to sample from GBS distributions on unweighted graphs, and prove that it mixes in polynomial time for dense graphs. Numerical experiments on 256-vertex graphs are conducted, demonstrating that the algorithm improves the performance up to 10x.

Yexin Zhang, Shuo Zhou & Tongyang Li

Article
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A planar chiral organoselenium enabled enantioselective intramolecular oxidation of trisubstituted olefins

Electrophilic selenium catalysis has recently emerged as an attractive synthetic strategy, yet the field of enantioselective electrophilic selenium catalysis remains underdeveloped, primarily due to the scarcity of efficient chiral catalysts and limited reaction types. Herein, the authors disclose the design and synthesis of a series of novel planar chiral organoseleniums based on [2.2]paracyclophane.

Wanjiang Zhu, Fang-Yu Fu & Wen-Hua Zheng

Article
22 October 2025 | Open Access

Modulating physicochemical interfaces enables li-rich oxides based ceramic solid-state li batteries under ambient conditions

Strong oxidative oxygen species generated at high voltage pose great challenges to positive electrode-side interface stability in lithium-based batteries. Herein, authors propose a robust gel polymer electrolyte with bifunctional additives for interface modification, achieving high-voltage ceramic solid-state lithium batteries.

Xinchao Hu, Shuqi Shen & Qingshui Xie

Article
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Long-life aqueous zinc-iodine flow batteries enabled by selectively intercepting hydrated ions

Aqueous zinc-iodine flow batteries show potential in large-scale storage but face water imbalance-induced instability. Here, authors develop a tailored ionic-molecular sieve membrane that selectively intercepts hydrated ions, enabling stable high-capacity long cycling with low projected costs.

Zhiquan Wei, Yiqiao Wang & Chunyi Zhi

Article
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Systematic mapping of altermagnetic magnons by resonant inelastic X-ray circular dichroism

Using circularly polarized inelastic X-ray scattering, the authors map spin-wave (magnon) excitations in the altermagnet CrSb and detect a reversible chiral signal for the first time, establishing a practical method to probe altermagnetic magnons.

Nikolaos Biniskos, Manuel dos Santos Dias & Petr Čermák

Perspective
21 October 2025 | Open Access

Using in-situ small-angle scattering to reveal the structure and dynamics of supramolecular polymers

Small-angle scattering is widely applied to nanoscale material systems enabling in-situ measurements, statistically significant analysis and the study of stimuli dependent dynamic changes. Here, the authors show how small-angle scattering techniques can be applied to the characterization of supramolecular polymers and complement other routinely used techniques.

Martin Hollamby, Hiroki Hanayama & Shiki Yagai

Article
21 October 2025 | Open Access

Non-volatile tuning of cryogenic silicon photonic micro-ring modulators

Researchers demonstrate non-volatile tuning of cryogenic silicon micro-ring modulators using phase-change materials, enabling scalable, low-power, high-speed optical links for quantum computing, high energy physics and cryogenic systems.

Uthkarsh Adya, Sridhar Singhal & Sajjad Moazeni

Article
21 October 2025 | Open Access

Field-resilient supercurrent diode in a multiferroic Josephson junction

The authors demonstrate a zero-field supercurrent diode effect in $NbSe_2/NiI_2/NbSe_2$ vertical Josephson junctions, where NiI_2 is a two-dimensional multiferroic material. The diode efficiency is even as a function of field, making the device "resilient" to stray fields from nearby circuit components.

Hung-Yu Yang, Joseph J. Cuozzo & Kang L. Wang

Article
21 October 2025 | Open Access

Porous membranes enable selective and stable zero-gap acidic CO_2 electrolysers

Efficient and stable CO_2 reduction in acidic zero-gap electrolysers remains challenging. Here, the authors use porous membranes with strong water permeability and bidirectional ion transfer to enable stable and scalable acidic CO_2 electrolysis.

Shilei Wei, Hang Hua & Jingshan Luo

Article
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A Bayesian approach towards atomically-precise localization in fluorescence microscopy

The authors present DIGIT, a Bayesian imaging method that maps quantum emitters to lattice sites, achieving 0.178 Å precision and a new exponential scaling law, enabling massively parallel, sub-ångström localization in quantum and biological systems.

Yuqin Duan, Qiushi Gu & Dirk R. Englund

Article
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A multi-resolution systematically improvable quantum embedding scheme for large-scale surface chemistry calculations

Surfaces are the stage for vital catalytic reactions, but accurately simulating them is computationally expensive. Here, the authors introduce an efficient method using GPUs to model large, complex surfaces with exceptionally high, experiment-matching accuracy

Zigeng Huang, Zhen Guo & Dingshun Lv

Article
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Directed self-assembly of chiral liquid crystals into biomimetic bouligand structures in thin film

Bouligand structures, which offer strength in natural materials, are of interest but difficult to obtain. Here, the authors report the development of such structures by directed self-assembly of cholesteric single crystals into hierarchical helical structures, with the secondary structure having right and left-handed twists.

Tejal Pawale, Justin Swain & Xiao Li

Article
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Integrated silicon nitride devices via inverse design

The authors harness the potential of inverse design to create efficient silicon nitride photonic devices through ultra-compact mode/wavelength multiplexers and a polarization beam splitter.

Julian L. Pita Ruiz, Narges Dalvand & Michaël Ménard

Article
21 October 2025 | Open Access

Differential stability and dynamics of DNA-based and RNA-based coacervates affect non-enzymatic RNA chemistry

Mixtures of peptides and nucleic acids tend to demix and form coacervate droplets. Here, the authors show that even short peptides and oligonucleotides form droplets. DNA and RNA impart different properties to these protocells – stability, fluidity and the potential to host RNA chemistry.

Karina K. Nakashima, Fatma Zohra Mihoubi & Claudia Bonfio

Article
21 October 2025 | Open Access

The role of phosphorus in the solid electrolyte interphase of argyrodite solid electrolytes

The continual growth of the solid electrolyte interphase on sulphide solid electrolytes is an impediment to solid-state battery adoption. Here, the authors reveal the role of phosphorus in the continual growth and give insights into how to prevent it.

Matthew Burton, Ben Jagger & Mauro Pasta

Article
21 October 2025 | Open Access

Fluorine-free gel polymer electrolyte for lithium oxide-rich solid electrolyte interphase and stable Li metal batteries

Stable solid-electrolyte interphases are crucial for lithium-metal batteries but often depend on costly and environmentally harmful fluorinated reagents. Here, the authors develop a fluorine-free polymer electrolyte that forms a highly stable O/N-rich SEI, significantly enhancing the battery cycling performance.

Weijian Xu, Lingxi Zhou & Lei Tian

Article
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Low-emission cement clinker precursor production, enabled by electrolytic extraction of calcium from waste cement

Cement production is one of the largest industrial sources of global CO2 emissions. This study presents an electrochemical process that recycles waste cement into hydrated lime for cement production, eliminating the need for limestone and reducing CO2 emissions by 99.8%

Tengxiao Ji, Shaoxuan Ren & Curtis P. Berlinguette

Article
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Crystallinity-dependent structural evolution of CoS_2 catalysts for enhanced oxygen evolution reaction

This work investigates crystallinity-dependent structural evolution mechanisms of CoS2 during the oxygen evolution reaction, showing that CoS2 with lower crystallinity enhances the transformation of the bulk phase into sulfur-stabilized oxyhydroxide, improving performance.

Nan Zhang, Yang Hu & Chun-Hua Yan

Article
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Solar-hybrid biocatalyst for methane hydroxylation to methanol

Methane monooxygenase (MMO) is capable of methane activation under ambient conditions, but most MMO applications are hindered by the slow electron transfer from NADH to the reductase and further to the hydroxylase. Here, the authors report an NADH-free biosolar platform for the conversion of methane to methanol, featuring high catalytic productivity using xanthene dyes as light harvesters.

Jinha Jang, Devashish Das & Chan Beum Park

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