

Physical sciences articles within *Nature Communications*

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Featured

Article

02 September 2026 | [Open Access](#)

Observation of a spin-textured nematic Kondo lattice

The authors study the layered Kondo magnet UTe₂ by spin polarized scanning tunneling microscopy and spectroscopy. They discover a spin-polarized nematic state below 15 K, coinciding with the formation of heavy quasi-particles driven by band hybridization.

Yu Xiao Jiang, Zi-Jia Cheng & M. Zahid Hasan

Article

01 September 2026 | [Open Access](#)

Ultrathin nano-layered boron nitride stabilizing perovskite quantum dot-based light-emitting diodes

Perovskite quantum dot light emitting diodes are promising for lighting and displays, but poor operational stability limits their use. Wang et al. added an ultrathin boron nitride interlayer to suppress defects, ion migration, and heat sensitivity, improving efficiency and lifetime.

Jiahui Wang, Hongyan Xie & Jianing Wang

Article

01 September 2026 | [Open Access](#)

Low-energy excitations and disorder-induced polarization and soliton jumping in a mechanical Markov system

Disordered mechanical systems can exhibit complex properties that are difficult to analyse. Here, the authors introduce a space-time mapping between one-dimensional mechanical systems and discrete-time dynamical systems to reveal disorder-induced polarization, nonuniform soliton transport, and other phenomena.

Will Stephenson, Nan Cheng & Xiaomeng Mao

Article

01 September 2026 | [Open Access](#)

Antichiral hinge states in a higher-order photonic nodal ring semimetal

The authors demonstrate antichiral hinge states in a photonic nodal-ring semimetal, revealing co-propagating one-way transport linking bulk, surface and hinge topology, robust to realistic disorder and reconfigurable by layer addition or removal.

Yuchen Peng, Deep Mondal & Gui-Jun Li

Article

01 September 2026 | [Open Access](#)

Coulombic surface dipole trapping ionomer for efficient proton exchange membrane fuel cells

Low-platinum fuel cells need catalytic layers that move protons and oxygen efficiently, but current ionomer placement limits performance. Here, the authors report a robust single-stem dipole coating which guides the placement, protects platinum surfaces and boosts power and durability.

Siyun Wang, Jingyue Xiang & Jianping Sun

Article

01 September 2026 | [Open Access](#)

Shape memory polymer adhesives for on-demand, low-force detachment in skin-interfaced devices

Skin interfaced devices require strong attachment, though adhesives lack mechanisms for on-demand adhesion. Here the authors design a thermally triggered shape memory polymer for reversible adhesion for medical devices.

Changhee Son, Uhyeon Kim & Jin-Tae Kim

Article

01 September 2026 | [Open Access](#)

Multilayer mesoporous vesosomes of block copolymer

The construction of multilayer mesoporous vesosomes that combine hollow multilayer shells with ordered mesopores remains a significant challenge. Here the authors report a molecular engineering strategy based on 3D-confined self-assembly to produce multilayer vesosomes with newly hexagonally ordered shell perforations.

Mian Wang, Jun-Ho Huang & Jintao Zhu

Article

01 September 2026 | [Open Access](#)

High Entropy Effect Induced In-situ Surface Hydroxylation for Robust Electro-assisted Uranium Mineralization from Real Nuclear Wastewater

A LaCoFeO₄/CaO₂ high-entropy perovskite that drives charge redistribution and in situ surface hydroxylation is reported here, achieving >98% U extraction from real nuclear wastewater. Advanced characterizations identify Cu as the key active site.

Huailin Yu, Xueqiang Feng & Wenbo Zhu

Article

01 September 2026 | [Open Access](#)

In-sensor multispectral perception for near- and mid-infrared discrimination

Achieving precise extraction of multispectral features is a critical bottleneck for near-generation vision systems. Fang et al. report a multispectral sensor that distinguishes input light in the visible/near-infrared ranges from that in the mid-infrared range at the sensor level, enabling in-sensor multispectral processing.

Shi Feng, Fakun Wang & Qi-Jie Wang

Article

01 September 2026 | [Open Access](#)

Quinone-heme π - π interactions bridge the biotic-abiotic interface for enhanced mechanosensing

Quinone-based conductive materials promote interfacial electron transfer and mechanosensing during anaerobic digestion, in which the material mediates the transfer of electrons produced from exoelectrogen to electrophoretic methanogens, but the underlying mechanism remains elusive. Here, the authors establish the electron transfer interface between reduced anthraquinone (HAQ2) and Methanosaeta loyarii in a microbial electrolysis cell, and reveal an intrinsic electronic complementarity between the electron-donating π -system of HAQ2 and the electron-accepting π -porphyrin ring of labile heme b.

Zhihao Jiang, Zhigang Zhao & Yeubin Zhang

Article

01 September 2026 | [Open Access](#)

A machine learning method for calculating highly localized protein stabilities

Phet is a machine learning model that infers residue-level protein stabilities from conventional hydrogen exchange-mass spectrometry data, transforming a widely used structural biology technique into a scalable tool for quantitative protein ensemble analysis.

Chenlin Lu, Kyle C. Weber & Arjun Gharghne

Article

01 September 2026 | [Open Access](#)

Hydrogen-helium immiscibility boundary in gas-giant planetary interiors from machine-learning molecular dynamics

The authors use machine-learning molecular dynamics simulations to map the hydrogen-helium immiscibility boundary under gas-giant interior conditions, constraining models of planetary structure and evolution.

Xinyao Wang, Sébastien Hamel & Binggang Cheng

Article

01 September 2026 | [Open Access](#)

Reprogramming product selectivity and activity in promiscuous terpene synthases via substrate conformation engineering

Simultaneously enhancing product specificity and catalytic performance remains a major challenge in terpene synthase engineering. Here, the authors elucidate the origin and stereoselectivity of a fungal germanene C₁₅ synthase, which catalyses the 1,5-cyclization of farnesyl diphosphate to form a central sesquiterpene intermediate, and demonstrate that engineering substrate conformation enables simultaneous improvement of product specificity and catalytic performance.

Sheng Dong, Hongshuang Liu & Hailuo Zhang

Article

01 September 2026 | [Open Access](#)

Engineering moiré potentials in twisted bilayer MoS₂ for selective single-molecule sensing

Twisted layers of van der Waals materials can generate moiré superlattices, forming reconfigurable surface potentials with nanoscale periodicity. Here, the authors show that the moiré potential in twisted bilayer MoS₂ can be used to confine aromatic molecules, improving the surface-enhanced Raman spectroscopy sensitivity and selectivity of this platform.

Hongshuang Zhao, Haoguo He & Yu Lu

Article

01 September 2026 | [Open Access](#)

Boron nitride nanotube fibers with over 1 GPa strength and 1000 °C stability for exceptional neutron shielding textiles

Researchers developed continuous, flexible boron nitride nanotube fibers achieving over 1 GPa strength and 1000 °C stability. Interwoven into lightweight textiles, they provide thermal neutron shielding for potential manned deep space missions.

Ki Hyun Ryu, Seok-In Lim & Dae-Yoon Kim

Article

01 September 2026 | [Open Access](#)

Construction of molecular fans in metal-organic framework to overcome diffusion resistance for trace benzene capture

Molecular size-matched pores provide strong adsorptive force but high diffusion resistance for benzene. This study installs molecular fans in size-matched pores of metal-organic framework to promote diffusion and dynamic capture of trace benzene.

Zhaowei Huang, Xi Yang & Wenbo Wu

Article

01 September 2026 | [Open Access](#)

Topological valley quasi-bound states in the continuum for radiatively accessible robust transport

Topological valley photonics enable robust on-chip light transport, but valley edge states lie outside the light cone, blocking free-space excitation. Here, authors fold these states into topological valley quasi-bound states in the continuum, enabling free-space coupling while preserving low-loss terahertz transport.

Mingqi Wei, Yang Long & Baile Zhang

Article

01 September 2026 | [Open Access](#)

Bacterial growth under confinement requires transcriptional adaptation to resist turgor pressure build-up

Bacteria often grow in confined spaces within biofilms, host cells or infection sites. Here, Le Blanc et al. show that E. coli growth in confined spaces generates pressures of hundreds of kPa, and is associated with formation of shorter bacterial cells, cytoplasmic crowding, increased turgor pressure, and activation of stress responses.

Laure Le Blanc, Baptiste Abic & Darin Bonacci

Article

01 September 2026 | [Open Access](#)

Submolecular video-imaging of the Smc5/6 complex topologically bound to DNA

SMC complexes regulate higher-order genome architecture through their unique DNA-binding activities. Using HI-AFM the authors reveal the submolecular dynamics of Smc5/6 on DNA, providing mechanistic insight into this ATP-dependent interaction.

Kazuhiko Umeda, Yumiko Kurokawa & Yasuo Maruyama

Article

01 September 2026 | [Open Access](#)

Effect of liposome rigidity on corona formation and its implications for uptake by cells

Nanoparticle rigidity affects their cell uptake and in vivo behaviour, but the mechanisms remain unclear. Here, the authors show that rigid and soft liposomes form different coronas in serum and only when the corona is present does the uptake occur.

Xinyu Ma, Feng Zhao & Anna Salvioli

Perspective

01 September 2026 | [Open Access](#)

Using X-ray free electron lasers to explore extreme states under quasi-static compression

X-ray free electron laser pulses can create and probe extreme states of matter at femtoseconds, conditions, and thermodynamic pathways which are inaccessible using conventional techniques. This perspective outlines notable results and questions raised by recent experiments on pre-compressed samples, and how these can be addressed in the future.

Rachel J. Hubbard, R. Stewart McWilliams & Zuzana Konopkova



Article

01 September 2026 | [Open Access](#)

Proton signal enhancement of three orders of magnitude in high-field liquid-state NMR

Nuclear magnetic resonance often suffers from low sensitivity. Here the authors demonstrate that, by hyperpolarizing protons using the radical CRISOL, one may achieve signal enhancements of more than 1000 in high-field solution NMR.

Kajun Laflamme, Dimitri Zaslavski & Simon Molot



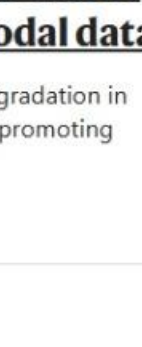
Article

01 September 2026 | [Open Access](#)

Isotope-labeled growth histories reveal persistent chirality in individual carbon nanotubes despite catalyst evolution

The carbon nanotube structure is often assumed to be dictated by the size of the catalyst nanoparticle. Here, the authors show that each nanotube retains its original structure over hundreds of micrometres, even when the catalyst is consumed and its growth rate changes.

Kaigo Otsuka, Ryota Fujiwara & Shigao Maruyama



Article

01 September 2026 | [Open Access](#)

Highly efficient long-range conduction through a biosynthetic nickel-organic framework

Cable bacteria are filamentous microorganisms able to transport electrical currents over centimetre distances, giving them a natural advantage in aquatic sediments. The molecular basis of this conductivity has remained unclear. This study shows that electron transport occurs through a continuous nickel-based organic framework located within periplasmic fibres that span the centimetrelong bacterial filaments. This finding clarifies how efficient long-range conduction is achieved and highlights a promising biological model for developing innovative bio-based electronic materials.

Filip J. R. Mayheux, Brent Smet & Henriette T. S. Bockhorst



Article

31 August 2026 | [Open Access](#)

Unassisted bipolar photoelectrochemical synthesis of H₂O₂

PEC H₂O₂ production usually suffers from low selectivity and poor stability. This study shows a Zn-TiO₂/VCWO₂/Pt/CuCoNiO-RED bipolar system that enables efficient and stable H₂O₂ synthesis under sunlight, achieving a combined Faradaic efficiency of 93.27%.

Haojie Chen, Rui-Ting Gao & Limin Wu



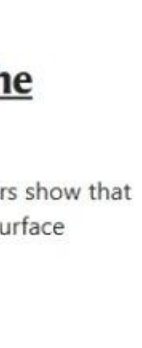
Article

31 August 2026 | [Open Access](#)

Predicting ionic conductivity of sulfide glass solid-state electrolytes using max-flow methodology

Here authors present a max-flow method that uses static glass structures to predict how fast ions move, especially in sulfide glasses, helping to accelerate the discovery of high-performance electrolyte materials for batteries.

Matteo Pegoraro, Rasmus Christensen & Morten M. Smedskjær



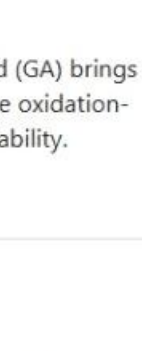
Article

31 August 2026 | [Open Access](#)

Grain boundary segregation of ceramic aerogels for reliable thermal insulation at extreme conditions

Grain boundary segregation enables ceramic aerogels with high thermal stability and reliable thermal insulation at temperatures up to 1500 °C, offering a strategy for designing lightweight thermal protection materials for extreme environments.

Zhenhui Yin, Yingjie Zhao & Xiang Yu



Article

31 August 2026 | [Open Access](#)

Calcium-tolerant electrode strategy for efficient hydrogen peroxide electrocatalysis in natural water

Calcium scaling is widely considered a major barrier to decentralized H₂O₂ electrocatalysis. Here, the authors identify dissolved Ca²⁺ as the key factor limiting H₂O₂ production and develop calcium-tolerant cathodes through electrode/electrolyte interfacial engineering for efficient H₂O₂ production.

Kai Wang, Yiqing Zhu & Kai Wang



Article

31 August 2026 | [Open Access](#)

An interpretable learning framework for exploring superelastic degradation of NiTi shape memory alloys using multimodal data

This manuscript highlights an interpretable learning framework to explore superelastic degradation in NiTi alloys, revealing mechanisms linked to grain orientation and Ni4Ti3 precipitates, and promoting data-driven design of shape memory alloys.

Yuejie Hu, Haiyang Wang & M. W. Fu



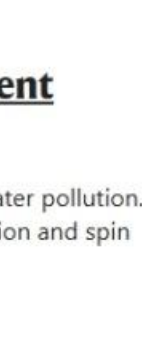
Article

31 August 2026 | [Open Access](#)

Multi-modal learning with incomplete data

Incomplete multi-modal datasets pose a major challenge for real-world machine learning applications. Here, authors present BMML, a unified open-source Python package designed to analyze and integrate incomplete multi-modal datasets for diverse machine learning tasks.

Alberto López, John Zobelka & Tero Aittakallio



Article

31 August 2026 | [Open Access](#)

FRa Micromap (uMap) proximity labeling reveals fulvestrant mechanisms

This study used a proximity-labelling technique to reveal how the breast cancer drug fulvestrant alters estrogen receptor interactions. The findings clarify its mechanism and provide a framework for evaluating next-generation estrogen receptor therapies.

Chun Li, Zhen Dong & David W. C. Mackintosh



Article

29 August 2026 | [Open Access](#)

Strong and crack-tolerant elastomers via geometrically confined H-bonding semicarbazides

The development of high-performance elastomers that are strong, crack-tolerant, and wear-resistant remains a challenge. Here the authors design a poly(urethane-urea) system based on geometrically confined semicarbazide chain extenders, which enhance the mechanical performance of the material.

Ruiqun Li, Shuyao Pan & Feifei Wang



Article

29 August 2026 | [Open Access](#)

Many-body interactions resolve halide distribution at the air/water interface

How halide ions distribute at the surface of water has long been debated. Here, the authors show that cooperative molecular interactions suppress adsorption, leaving only halide with a weak surface preference.

H. Agreles, R. Rashedi & F. Pascale



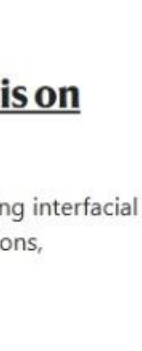
Article

29 August 2026 | [Open Access](#)

Cascade electrocatalysis of glycolic acid from ethylene and oxygen with an energy efficiency of 62.5%

The industrial implementation of ethylene glycol oxidation reaction (EGOR) to glycolic acid (GA) brings promise but poses a challenge for ethylene cost. Here, the authors report an ORR-ethylene oxidation-EGOR cascade conversion strategy that can boost both energy efficiency and economic viability.

Jin Wang, Ningxin Zhao & Shaojun Guo



Article

29 August 2026 | [Open Access](#)

Partial coherence control delivers skyrmionic topological resilience and transitions

The authors show that partial coherence can stabilize optical skyrmions against strong atmospheric turbulence and drive controllable topological transitions during free-space propagation.

Yongfeng Liu, Shiqi Chen & Fei Wang



Article

29 August 2026 | [Open Access](#)

Nanofibrous aerogels with continuous conductivity gradient for ultrabroadband absorption-dominant electromagnetic interference shielding

Electromagnetic interference shields can be limited by impedance mismatch with free space, leading to strong reflections and secondary radiation. Here, the authors introduce lightweight all-polymer aerogels with a continuous through-thickness conductivity gradient, fabricated in a single step via diffusion-driven oxidative polymerization of pyrrole within aramid-nanofiber scaffolds.

Yongqin Chen, Huimin He & Zhihui Zeng



Article

29 August 2026 | [Open Access](#)

Programmable mesoporous carbon architectures from liquefied wood via reactive emulsion-mediated self-assembly

Developing biomass-derived self-assembly systems for controlling carbon morphology remains challenging because of their intrinsic heterogeneity, which hinders controllable assembly. Here, the authors report a biomass-enabled reaction-emulsion-mediated strategy for converting liquefied wood into various mesoporous carbon nanostructures.

Yang Li, Kun Zhang & Shoulin Liu



Article

29 August 2026 | [Open Access](#)

Coupled spin-coordination self-adaptation drives efficient nitrate to ammonia conversion

Producing ammonia from nitrate could help address both chemical manufacturing and water pollution. Here, the authors show that as low single-atom catalyst dynamically adjusts its coordination and spin state to promote nitrate conversion to ammonia.

Chun-Kuo Peng, Yu-Ru Lin & Yan-Qin Lin



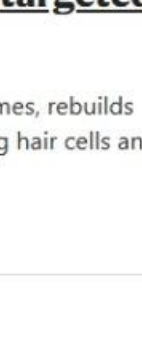
Article

29 August 2026 | [Open Access](#)

Ionic gel-mediated synthesis of nanostructured chiral 2D halide perovskites with amplified chiroptical response

An ionic gel-mediated method to synthesize nanostructured 2D chiral halide perovskite films was developed. By minimizing crystal defects, this breakthrough drastically amplifies chiroptical properties for next-generation photonic devices.

Duo-Rijong Lee, Raphael F. Moral & Carolina M. Sutter-Fella



Article

29 August 2026 | [Open Access](#)

Macrocytic molecular engineering enables high-energy and durable organic electrode for lithium-ion batteries

Organic electrode materials face a persistent capacity-stability trade-off. Here, authors design a macrocycle combining covalent organic framework-like robustness with small-molecule redox efficiency, which renders a capacity of 805 mAh g⁻¹ at 50 mA g⁻¹ and retains 87% capacity after 1000 cycles at 5 A g⁻

Physical sciences articles within Nature Communications



Featured

Atomistic machine learning with irreducible Cartesian natural tensors
A theory of Cartesian tensors gives rise to Carlet, a unified machine learning framework that predicts the properties of molecules and materials with leading accuracy, from inelastic neutron energies to complex, high-rank elastic tensors.
Qun Chen, A. S. L. Subramanyam Parthasarathi & Minghan Wen

Towards density-optimal DNA storage with practical bijective coding
Encoding DNA storage methods struggle to avoid error-prone sequences while retaining usable ones. Here the authors develop Sipax Code, a bijective code that avoids high-error patterns, utilizes all suitable strands, and reaches 14.4 kb/100 bases, 41% bit/gram, and only uses 6 cytosines.
Jiawen Li, Mingqiu Cheng & Hailiang Guo

Quantum nonlinear optics for optical neural computing
Optical neural networks could cut the energy cost of AI, yet linear optical nonlinearity limits their capability. Here, the authors propose activation units by embedding a quantum emitter in an inverse-designed photonic structure, numerically demonstrating all-optical deep learning at nanowatt-scale intensities.
Qingli Zhou, Jungrin Kim & Zongfu Yu

Gating hole back-transfer with molecular spacers programs rapid micropollutant decontamination
This work demonstrates that molecularly designed C6F spacers enhance charge transport and oxygen activation, enabling efficient reactive oxygen species generation and rapid micropollutant removal from water.
Zhou Wenyan, Qiu Chencheng & Fan Wu

Carbonyl-staggered covalent organic frameworks for high-rate and stable rechargeable calcium-organic batteries
Calcium batteries require high-capacity cathodes with fast ion-diffusion kinetics. Here, authors reported a carbonyl-staggered covalent organic framework that yields alternating configuration of active sites in flexible skeleton for rapid Ca²⁺ hopping and high-capacity utilization.
Yiyuan Liu, Zhongyao Yin & Zheng Long Yu

Tough, thermal-insulating and scalable puff pastry-inspired architected cementitious material via simple rolling-folding
Inspired by puff pastry, this research highlights a lamellar cementitious material that combines high mechanical toughness, scalable fabrication and effective thermal insulation, offering a route toward safer and more energy-efficient infrastructure.
Kailun Xia, Yanning Chen & Yanni Zhang

Kinetically inert covalent adaptable networks enable holistic resource recovery from high-performance printed circuit boards
The accumulation of electronic waste demands sustainable strategies for printed circuit boards, a goal limited by the use of end-capable resins. Here the authors develop a kinetically inert covalent adaptable network designed for recyclable high-performance printed circuit boards based on gem-disubstituted difunctional epoxy resins.
Huijun Hu, Tianji Song & Changyao Guo

Automated transition state generation for mechanistic exploration in organic synthesis
The authors develop UNTS, a unified framework for automated transition state generation that combines a diverse transition state dataset with equivalent diffusion learning to accelerate mechanistic exploration.
Li-Cheng Xu, Junyi An & Yuan Qi

Confined shear-induced structure discretization enables re-entrant super-repellent metals
Researchers fabricate re-entrant microstructures on metals through a confined shear-induced structure discretization (CSIS) mechanism using a cave-trapezoid cutting tool, resulting in durable, liquid-repellent surfaces.
Xuanxuan Wang, Tongjie Guo & Lei Zhang

Sustained formation movement and destruction of coacervates in a waste-free system driven by electricity
Coacervates are important models for proto-cells, but development of out-of-equilibrium systems is challenging. Here, the authors report the transient formation and movement of coacervates, with the electric potential between two electrodes used as the energy source.
Svetlana Samokhvalova, Kallopi Founti & Guillermo Morales Santiago

Precision high-speed quantum logic with holes on a natural silicon foundry platform
Silicon hole spin qubits promise fast electrical control but have lagged behind electron spins due to disorder sensitivity and complex spin physics. Here, the authors demonstrate record single-qubit gate fidelities and two-qubit gates with high quality factor in natural silicon using an industrial CMOS process.
Isaac Vorobiev, Jonathan Y. Huang & Alexander R. Hamilton

Probing magnetic correlations in space and time within predefined topological sectors of a macroscopic spin liquid
Certain on-lattice frustrated spin models are expected to develop a spin liquid ground state partitioned into topological sectors, whose exploration is so far inaccessible to experiments. Here, using millimeter-sized magnets, Dingemans et al. present an artificial, macroscopic realization of such a model, the seminal triangular Ising antiferromagnet.
Rémy Dingemans, Jeanne Colbois & Johann Coxau

Resolving root causes of experiment discrepancies guided by machine learning
The authors present a framework to identify and resolve discrepancies between experimental datasets. Combining Bayesian machine learning with expert analysis, they uncover hidden sources of bias in historical measurements.
D. Neudecker, K. J. Kelly & R. C. Haight

Umbrella-type stretchable electrode arrays for long-term neural recording
Stable recording of high-density neuronal ensembles at single-unit resolution over years-long timescales is challenging. Here, the authors develop umbrella-type stretchable electrode arrays anchored to surrounding brain tissue, forming a neuroelectronic interface that tracks the same neuronal ensembles in head-fixed mice over 1.5 years.
Jin Bai, Jie Li & Lei Gao

Regulated liquid metal via semiconductor valve toward highly stretchable topological circuits
Fabricating 3D flexible electronics is challenging due to the difficulty in obtaining highly stretchable materials with precise current control and complex topological structures. Here, the authors report a unidirectional conductive semiconductor valve in liquid metals for soft, complex topological circuits.
Jiangli Wei, Zhenghan Kou & Jinyang Zhang

3D printed designer color routers with low refractive index for low-light imaging
The authors demonstrate a 3D-printed low-refractive-index color router that replaces absorptive color filters, improving light collection and enabling brighter, more efficient color imaging under both normal and low-light conditions.
Cheng Hong Fan, Guo Wang & Joel K. W. Yang

Long-range two-dimensional exciton sensitization of triplet-pair emission
Here, the authors report that a single layer of WSe₂ enhances light emission from normally dark, spin-entangled triplet pairs in a single fusion material by over 100-fold, enabling energy transfer across distances greater than 100 nanometers.
Guohui Ma, Zachary T. Gardner & Libai Huang

Anisotropic shape-shifting robotic matter enabling versatile collective behaviors
Trihex robots employ a single-motor mechanism to dynamically transform between triangular and hexagonal shapes, enabling diverse and adaptive collective behaviors in robotic materials.
Yunqiu Zhang, Chenxuan Huang & Shiqiang Li

Liquid network crosslinked hydrogels control material dynamics across multiple length scales through liquid movement
Native tissues exhibit distinct dynamics across multiple length scales owing to their hierarchical network architecture. Replicating these behaviors in engineered materials remains challenging because macroscopic viscoelasticity and nanoscale mobility are difficult to tune independently. Here, the authors develop a structural hydrogel in which self-assembled liquid nanostructures are covalently integrated into polymer networks, enabling independent control of viscoelasticity and nanoscale mobility.
Nad J. Egaña, Michelle S. Huang & Sarah C. Holzman

A 3D conductive amorphous unsaturated ligand MIL-68(Fe) MOF as room-temperature H₂S chemiresistive sensor
In this study, authors construct amorphous Fe metal-organic frameworks, where the Fe atoms act as catalytic and conductive sites. The resulting material can be exploited for the direct construction of chemiresistive gas sensors.
Guoliang Xu, Linjuan Zhang & Guotao Duan

Brittle materials-based fully stretchable organic light-emitting diodes
Stretchable devices are limited by random cracking and efficiency degradation under strain. Here, the authors present an active crack engineering strategy for brittle small-molecule organic semiconductor, enabling stretchable OLEDs with a maximum current efficiency of 63.7 lm/W and a tensile strain of 250%.
Chuang Xue, Xiaoli Zhao & Yichun Liu

Self-locking non-volatile coding metasurfaces via origami-based mechanical bits
Maintaining states without continuous power remains challenging for tunable metasurfaces. The authors present self-locking non-volatile coding metasurfaces based on origami mechanical bits, enabling holographic imaging and beam steering.
Ding Zhang, Jiepeng Li & Zujiao Wang

Revealing 3D strain and carbide architectures in additively manufactured Ni superalloys
Researchers present a highly detailed, synchrotron-resolved, 3D microstructural investigation of how tiny structures/defects form inside nickel superalloys during metal additive manufacturing, with the goal of helping engineers build tougher jet engines and turbine parts.
James A. D. Ball, David M. Collins & Yunhui Chen

Non-Hermitian topology from edge transport in Hermitian quantum anomalous Hall systems
Here, the authors show that the interplay between chiral and normal edge transport in a quantum anomalous Hall system can generate non-Hermitian topology, producing measurable exponential patterns in voltage, heat dissipation, and conductance.
Humian Zhou, Ming Lu & X. C. Xie

Yolk-shell zeolite nanoreactors enable multi-poison resistance for NO_x reduction
Ammonia selective catalytic reduction for stationary NO_x removal is limited by catalyst deactivation caused by SO₂ and alkali metals in flue gas. Here, the authors develop a zeolite-confined yolk-shell nanoreactor that enables stable long-term operation under industrially relevant poisoning conditions.
Yonglong Li, Guobin Li & Honggang Peng

Gradual Destruction of Refractory Stardust in Alkali Brines on Asteroid Bennu
Samples from asteroid Bennu show that salty, alkaline brines on its parent body slowly destroyed even the most refractory presolar stardust grains while leaving organic molecules intact, revealing how watery activity can erase a rock's record of its stellar origins.
Pierre Hennevoire, Jessica J. Barnes & Daniele S. Lauretta

In-silico solute transport via perivascular networks in the human intracranial space
This work introduces a multiscale, integrative modeling framework for brain fluid flow and solute transport, linking mesoscale perivascular networks with the organ-level macro-scale and timescales of seconds to hours to subject-specific geometries.
Markus Casermann, Miralote Kuchta & Marie E. Rogues

Composites of covalently linked lignin and cellulose from one feedstock
Most lignocellulose-derived materials utilize either lignin or cellulose, separating them and using them independently. Here, the authors produce a high-strength composite material from lignocellulosic biomass which combines both lignin and cellulose, so neither fraction is wasted.
Shida Zuo, Lars William Schick & Joseph S. M. Sauer

Catalyst-controlled reproductivity in enantioselective synthesis of spirocyclic γ- versus δ-lactams
Spirocyclic γ- and δ-lactams are privileged structural motifs widely found in medicinal chemistry and natural products. The authors report a regioselective strategy for the catalytic asymmetric synthesis of enantioenriched spirocyclic γ- and δ-lactams from a single cyclic allylic ether-derived ketone precursor.
Shao-Hua Wu, Fan Gong & Qing-Hai Deng

The potential of syngas as a central mediator for a carbon-agnostic circular economy
Bioprocesses utilizing waste streams must be established to enable sustainability. Here the authors propose syngas (a mixture of CO, H₂ and CO₂) as a universal feedstock to decouple upstream waste heterogeneity from downstream chemical and biotechnological manufacturing.
Jae L. Koelschmann, Michael Köpke & Steffen N. Lindner

Observation of Antichiral Hinge States in a Three-dimensional Gyromagnetic Photonic Crystal
This work reports the observation of antichiral hinge states in a 3D gyromagnetic photonic crystal. Extending antichirality to higher-order topology, it reveals a topological semimetal with co-propagating transport along parallel hinges.
Yizao Wang, Tanchi Xia & Zhen-Guo

Direct visualization of complex mechanisms in lithium tellurium porous batteries
Lithium-tellurium batteries promise high-energy storage, but their reaction pathways remain poorly understood. Here, authors directly visualize solid Li₂Te intermediates and show that the path-dependent growth and persistence govern electrode morphology, utilization and cycling performance.
Hyo-Teol Choi, Miyeon Kim & Seung-Ho Yu

Knowledge-informed graph attention networks enable defect-free alloy design for laser additive manufacturing
The authors report a machine-learning framework that combines a physical-metallurgy knowledge graph with uncertainty analysis to design alloys for laser powder bed fusion from small datasets, yielding crack-free nickel and aluminum alloys with high performance.
Jialin Fu, Hao-Yu & Wei Xu

Mechanical flexibility and pressure-activated emission in room-temperature phosphorescent organic crystals
Rigid molecular geometry enables mechanically flexible organic crystals with pressure-activated phosphorescence and reveals how the proportion of ¹n, n¹ character affects spin-orbit coupling.
Yunxia Shen, Zhi Chen & Yujun Zhang

Stabilization of charged domains in ferroelectric BiFeO₃ nanoneedles
The authors propose a top-down strategy of modifying the surface boundary conditions in a BiFeO₃ nanoneedle sample through ion milling. Surface curvature gradients and terminations induce charge compensation and ferroelectric effects that facilitate charge domain wall stabilization.
Francisco Guzmán, Christopher Adiego & Xiangping Fan

Copper-catalyzed enantioselective allylation of cyclic anhydrides for generation of multiple chiral centers
The efficient construction of multiple chiral centers in a single catalytic step is challenging due to the issues of both enantioselectivity and diastereoselectivity. Here, the authors report a copper-catalyzed reaction between non-symmetric monocyclic or meso bicyclic anhydrides and 1,1-disubstituted alkenes for simultaneous generation of multiple chiral centers.
Zhenhuihui Xu, Yuan Yuan & Shengping Ma

Uncover the strength of polyhedral dicarboranes as the next generation of superbases in organocatalysis
The authors synthesize a compound derived from a carbane bearing N-heterocyclic carbene, which exhibits superbasic properties with proton affinity surpassing that of the parent carbene as well as commercial superbases. The base facilitates various Lewis base-catalyzed transformations, including aldol condensation, the Thorpe reaction, Michael addition and Robinson annulation, with high efficiency and selectivity.
Jan Vilhina, Zuzana Kapustova & Alán Ríos-Ciñka

Ionotronic effect based on triboelectrically induced ion polarization at semiconductor-liquid interfaces
This work introduces an ionotronic effect that enables efficient energy conversion at semiconductor-liquid interfaces through coupling of triboelectric polarization, electrical double layers, and band modulation.
Xiang Li, Yu Wei & Wei Di

Axial dysprosium cyclopentadienyl amide single-molecule magnets with hysteresis up to 92 kelvin
Molecules showing magnetic memory effects at high-fidelity digital twin systems for parallel sorting, integrating real-time data and device mechanisms, and propose a structured Monte Carlo tree search framework that combines integer nonlinear programming and geographic graph modules to optimize grid-to-distribution assignments, improving throughput and reducing congestion in large-scale distribution centers.
Ran Li, Wei Zhang & Chuan Huang

Near-infrared-active Nd-BiO₂/MIL-101(Fe) with vacancy-induced interfaces for solar water purification
Vacuum-engineered Nd-BiO₂/MIL-101(Fe) heterostructures enhance solar-driven micro pollutant degradation through utilizing oxygen vacancies and optimized charge transfer mechanisms.
Shan Liu, Zhenqiang Chen & Shao Zhan

Electronic and solvent reorganization in proton-coupled electron transfer captured by ultrafast X-rays
Using ultrafast X-ray spectroscopy and scattering, the authors enable atomic-site-specific observations of a sequential proton-coupled electron transfer, revealing electron redistribution and solvent reorganization following photoexcitation and subsequent protonation.
Abdullah Karaman, Michael Sachs & Elisa Bacin

Amide synthesis via molecular shuffling of carboxylic acids
The amide bond represents the most fundamental functional group in chemistry and biology. Herein, the authors report an approach to amide synthesis that relies on molecular shuffling of carboxylic acid functional group.
Chengling Li, Qihang Fan & Tingjun Chen

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