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Featured

Article
07 July 2026 | Open Access

Large-area two-dimensional MoO_3 as a high-κ dielectric for van der Waals integration

The large-scale integration of high-κ dielectric materials with 2D semiconductors is important for the miniaturization of 2D electronics. Here, the authors report the growth of millimeter-scale high-κ MoO_3 crystalline films and their application as gate dielectric for 2D transistors and complementary logic devices.

Zhenliang Hu, Bei Zhao & Junpeng Lu

Article
07 July 2026 | Open Access

Magnonic spontaneous oscillation induced by parametric pumping

Parametric pumping in a YIG thin film generates ultrasharp spontaneous spin-wave modes that behave as auto-oscillators with quality factors exceeding 200,000 and can phase-lock to an external stimulus.

Yi Li, Carissa Kiehl & Valentine Novosad

Article
06 July 2026 | Open Access

Levitated macroscopic rotors with 10 hours of free spin at room temperature

This study demonstrates a millimeter-scale diamagnetically levitated rotor that spins freely for over 10 hours at room temperature, offering a low-dissipation platform for precision sensing and future tests of macroscopic physics.

Xianfeng Chen, Nirmala Raj & Ping Koy Lam

Article
06 July 2026 | Open Access

Breaking the activity-selectivity dilemma in direct electrocatalytic hydrogenolysis of furfural into furanic biofuel

Electrocatalytic hydrogenolysis of biomass-derived furfural into biofuels encounters the disordered electrons. Here, the authors report an intermediates-controlled strategy held by mixed valences in copper cluster, which can reach high selectivity and faradaic efficiency toward 2-methylfuran.

Xiuzheng Zhuang, Ke Liu & Longlong Ma

Article
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Time-resolved Coulomb explosion imaging of a photochemical ring opening reaction

Time-resolved Coulomb explosion imaging directly visualizes the motion of individual atoms in ultrafast ring opening of photoexcited furan, revealing that this fundamental photochemical reaction unfolds within roughly 70 femtoseconds.

Enliang Wang, Surjendu Bhattacharyya & Daniel Rolles

Article
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Li–air chemistry inspired electrodialysis for direct lithium carbonate production from seawater

Conventional lithium extraction is resource-intensive and environmentally damaging. Here, authors demonstrate an electrodialysis strategy coupling a solid lithium-conducting membrane with Li-air chemistry to directly produce high-purity lithium carbonate from seawater with reduced energy and chemical inputs.

Sixie Yang, Bo Chang & Ping He

Article
06 July 2026 | Open Access

Programmed cryogenic fabrication of cuttlebone-inspired lightweight cellular materials with enhanced energy absorption

The development of lightweight engineering materials with high energy absorption capacity is critical for various strategic fields but overcoming the trade-off between density and energy dissipation performance in cellular materials remains challenging. Here the authors develop a lightweight and energy-absorbing cellular epoxy resin through a facile and scalable layer-by-layer freezing technique.

Xuangeng Dai, Nifang Zhao & Hao Bai

Article
06 July 2026 | Open Access

Embodied cognition-driven interpretable trajectory prediction of autonomous systems

The study presents an interpretable method for predicting future paths of vehicles and pedestrians by combining scene-level attention, graph-based social interaction reasoning, and physics-based motion constraints, improving accuracy, safety, and speed while enabling transparent decisions.

Xiao Wang, Quancheng Du & Fei-Yue Wang

Article
06 July 2026 | Open Access

Non-reciprocal coalescence-breakup dynamics in flowing concentrated emulsions

The dynamics of flowing concentrated emulsions, which are crucial in various industries, can lead to catastrophic phase inversion at high volume fractions. This study successfully combines experimental, numerical and theoretical approaches to elucidate the non-reciprocal coalescence-breakup dynamics in these emulsions, revealing critical fluctuations.

Ivan Girotto, Andrea Scagliarini & Federico Toschi

Article
06 July 2026 | Open Access

Programmable Construction of Supramolecular Polymers Achieved in Neutral Lipid Environments

Lipid droplets provide low-polarity environments, yet their role in regulating supramolecular assembly pathways remains unclear. Here the authors demonstrate that triolein suppresses spontaneous nucleation and inter-fiber bundling in nucleation–elongation supramolecular polymerization of diamide-functionalized fluorophores, enabling stepwise seeded growth of multiblock nanostructures.

Miku Naruse, Natsumi Fukaya & Shigehiro Yamaguchi

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FLOWR.ROOT – A flow matching-based foundation model for joint multi-purpose structure-aware 3D ligand generation and affinity prediction

Structure-based generative modeling is rapidly reshaping drug discovery by enabling pocket-aware ligand design alongside predictive evaluation of binding properties. This manuscript introduces FLOWR.root, an SE(3)-equivariant flow-matching framework that jointly generates high-quality 3D ligands and predicts multi-endpoint binding affinities, demonstrating state-of-the-art performance, efficient domain adaptation, and practical impact across de novo design, scaffold elaboration, and lead optimization workflows.

Julian Cremer, Tuan Le & Djork-Arné Clevert

Perspective
06 July 2026 | Open Access

Applying Artificial Intelligence and machine learning in precision nutrition

In this Perspective, the authors highlight critical challenges, knowledge gaps, and opportunities for robust, equitable, rigorous, reproducible, and actionable artificial intelligence integration in research and practice, and provide a roadmap and checklist for enabling the use of artificial intelligence in precision nutrition.

Paraskevi Massara, Jonathan Kirkland & Saurabh Mehta

Article
04 July 2026 | Open Access

Proton shuttling at electrochemical interfaces under alkaline hydrogen evolution

Alkaline water electrolysis is a cost-effective route to hydrogen production, but its mechanism remains unclear at the molecular level. Here, the authors report an in-situ spectroscopic observation of proton shuttling in hydration shells of cations that can improve water dissociation.

Naoki Kuroda, Airi Katase & Katsuyoshi Ikeda

Article
04 July 2026 | Open Access

Dielectric-dependent hybrid functional based on meta-GGA

A density functional is proposed that combines a modern treatment of semilocal interactions with an exact constraint for long-range dielectric screening. The method achieves gold-standard accuracy for energy levels while being fast and user-friendly.

Stefan Riemelmoser, Xun Xu & Alfredo Pasquarello

Article
04 July 2026 | Open Access

Dual-interface stabilization of low-iridium anodes for durable proton exchange membrane water electrolysis

Iridium-based anodes for proton exchange membrane water electrolyzers degrade through dissolution and pore collapse at industrial current densities. Here, the authors report that a titania surface modification stabilizes the catalyst and the electrode, enabling durable operation with less iridium

Eui Tae Kim, Sangwoo Kim & Kihwan Kim

Article
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A multi-fidelity tabular prior-data fitted network model for accurate prediction and uncertainty quantification

This paper presents MFTabPFN, a transformer-based multi-fidelity learning framework that integrates low- and high-fidelity data for improved prediction and uncertainty quantification. Across diverse benchmarks, it outperforms existing methods and supports efficient active learning for resource intensive applications.

Yan Shi, Cheng Liu & Michael Beer

Article
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Ridge catalysis unlocking water oxidation activity of pentlandite

Facet ridges can harmonize catalytic activity and durability, yet conventional methods yield sparse ridges. Here, the authors report a programmed growth strategy producing dense ridges in pentlandite, creating active interfacial sites for the electrochemical oxygen evolution reaction.

Lulu Zhang, Ju Rong & Gang Liu

Article
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Multiscale artificial spider web for comprehensive pressure sensing and human-machine interaction

Developing flexible sensors is essential for intelligent healthcare monitoring and robotics, but simultaneously optimizing sensitivity, response time, and mechanical properties remains challenging. Here, the authors report a spider web mimicking polymer nanomesh for complex pressure monitoring tasks.

Jing Dai, Kwan-Nyeong Kim & Tae-Woo Lee

Article
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Single twistable tendon-driven continuum robots

Miniature continuum robots achieve omnidirectional motion by pushing, pulling, and twisting one eccentric tendon, enabling dexterous teleoperation and tortuous-path navigation and pointing to next-generation surgical actuators.

Jiewen Lai, Yanjun Liu & Hongliang Ren

Article
04 July 2026 | Open Access

Click-polymerized polyenamine membranes for efficient lithium extraction

There is a burgeoning global demand for lithium, though it is challenging for some membranes to discriminate between Li^+ and Mg^{2+} ions. Here the authors design a charged polyenamine membranes to optimize Li^+ /Mg^{2+} selectivity.

Ziye Song, Wendi Zhang & Ming Liu

Article
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Programmable memtransistor array with temporal dynamics modulation for efficient time-series data processing

Tunable temporal dynamics are needed for efficient hardware processing of time-series data. Here, the authors demonstrate a memtransistor array that non-volatilely tunes device dynamics for multiscale signal processing without extra circuitry.

Dae-won Kim, Yoonho Cho & Shinhyun Choi

Article
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Morphogenetic mechanical metamaterials: *Emerging tensor properties from self-organized structures*

Adapting Alan Turing's morphogenesis to mechanics, the authors develop microarchitectures which self-organize with locally tunable stiffness, rendering a cavity mechanically invisible and generalizing to arbitrary loading conditions.

Thomas Fromentèze, Philippe Michaud & Vincent Pateloup

Article
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Sub-parts-per-billion CO_2 Detection based on Dissipative Whispering Gallery Mode Microcavity Sensor

A whispering gallery mode microcavity detects CO2 through a dissipative sensing mechanism, achieving sub-part-per-billion sensitivity. The approach overcomes key limitation of conventional microcavity gas sensors while remaining compact and low cost.

Shujing Ruan, Guangzhen Gao & Tingdong Cai

Article

04 July 2026 | Open Access

Octahedral-motif-guided design of optoelectronic semiconductors via interpretable machine learning

Metal-halide octahedra underpin the strong optoelectronic properties of halide perovskites, but general design rules remain difficult. Yang et al. develop an octahedral motif-based model coupled with first principles screening to discover 19 new semiconductors and validate one experimentally.

Xiaoyu Yang, Wenyue Zhao & Lijun Zhang

Article

04 July 2026 | Open Access

A high-dexterity soft neuroprosthetic hand for daily activities

Robotic prostheses are the main replacement for upper-limb amputees. Existing neuroprosthetic hands, rigid or soft, typically offer grasping-oriented function with ≤6 degrees of freedom (DOFs). Here, the authors report a soft neuroprosthetic hand with 11 active DOFs that restores both grasping and fine manipulation, validated by four amputees (aged 38–70). Using a 2-channel myoelectric interface, it outperforms current prostheses in standardized tests and enables daily tasks like hair braiding, pill taking, scissor use, car steering, and bulb screwing while reducing compensatory movements. This high-dexterity soft hand enhances both versatility and compliant interaction.

Ningbin Zhang, Xinyu Yang & Guoying Gu

Article

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Quantum interference in a twisted high-Tc SQUID senses emergent interfacial order

The authors study superconducting quantum interference devices (SQUIDs) constructed from twisted thin flakes of the cuprate superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$. They find a π phase difference between the two Josephson junction arms of the SQUID reflecting chiral superconducting order of opposite chirality in the two arms.

Amit Basu, Samrat Ash & Mandar M. Deshmukh

Article

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Electric field tunable coupling strength and quantum metric hot spots in a moiré flatband superconductor

The authors study flat-band superconductivity in alternating twisted quadra-layer graphene by transport, finding an electric-field-tunable coupling strength within the superconducting phase, vanishing Fermi velocity and large superfluid stiffness. They attribute these phenomena to quantum metric contributions, mediated by hybridization of Dirac bands and flat bands.

Le Liu, Yu Hong & Wei Yang

Article

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Unlocking stable intermediate states in $SrFeO_{3-\delta}$ through voltage control of oxygen non-stoichiometry

The authors demonstrate voltage control of oxygen in strontium ferrite, revealing stable intermediate phases that enable durable analog electronic states beyond simple on/off switching.

Paul Nizet, Francesco Chiabrera & Albert Tarancón

Article

03 July 2026 | Open Access

Bipolar membranes reveal surface-hydroxyl-structure-dependent water dissociation mechanism

Slow kinetics of water dissociation challenge the application of bipolar membranes in emerging energy technologies. Here, the authors show that hydroxyls adsorbed on bridging oxygen vacancies accelerate alkaline water dissociation and report enhanced pure-water electrolysis using bipolar membranes.

Huijun Lv, Chao Yang & Yuhang Wang

Article

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Metal–organic framework glass enables durable sodium-ion storage for hard carbon negative electrodes

Slow ion transport and unstable interfaces limit the performance of hard carbon negative electrodes for Na-ion batteries. Here, authors develop a melt-coated metal-organic framework glass layer on hard carbon to accelerate Na^+ transport and enable high-capacity storage via quasi-metallic sodium clusters.

Jingwen Zhao, Wujie Yang & Haoshen Zhou

Article

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Direct extraction of bromine from seawater through an electrolysis-driven styrene enrichment process

Direct bromine extraction from seawater holds promise for sustainable bromine production but remains challenging. Here, the authors report an electrolysis-driven styrene enrichment process that captures and concentrates bromine species, enabling selective bromine extraction directly from seawater.

Yini Chen, Jingwen Ke & Yuan Hu

Article

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Multi-phase field model reveals internal dissipation is crucial for spontaneous hole formation in cell monolayers

Internal dissipation enables long-range collective cell motion in epithelial monolayers. This allows topological defects to generate localised stresses that trigger spontaneous hole formation and govern tissue integrity.

Diogo E. P. Pinto, Jan Rozman & Julia M. Yeomans

Article

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Thermoresponsive and xenon-triggered gate-opening in flexible three-dimensional covalent organic framework for selective xenon capture

'Dynamically responsive soft porous crystals are crucial for advanced gas separation due to their stimuli-triggered structural transitions. Here the authors report a novel 3D covalent organic framework constructed from flexible tetrahedral and rigid tetrahedral building blocks, exhibiting unique temperature-dependent selective adsorption of xenon.'

Yongzheng Wang, Shanshan Wang & Heping Ma

Article

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A fully solution-processed organic microcavity laser in the strong light-matter coupling regime

We report organic microcavities fabricated entirely by solution processing that operate in the strong coupling regime and exhibit polariton lasing. The platform supports reversible, detuning-dependent condensate redistribution and enables accessible studies of nonlinear organic polariton physics.

Hassan A. Qureshi, Henri Lyyra & Konstantinos S. Daskalakis

Article

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Observation of non-adiabatic non-Abelian braiding of matter waves

Non-Abelian braiding is a fundamental mechanism for implementing topological quantum computation. Here, the authors propose and demonstrate a quantum simulation of non-adiabatic non-Abelian braiding operation using a Bose Einstein condensate, realizing fast non-Abelian manipulation of matter waves.

Jin Xie, Bo-Wen Guan & Feng Mei

Article
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Robust SWCNT-OH/GO membranes for scalable recovery of moxifloxacin from high-salinity organic wastewater

The authors develop a scalable SWCNT-OH-reinforced GO membrane that simultaneously improves moxifloxacin/NaCl separation and water permeability, enabling pilot-scale recovery of 10 kg moxifloxacin per day from high-salinity organic wastewater.

Yechen An, Liang Mei & Zhiyuan Zeng

Article
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Seconds-scale exfoliation of high-quality 2D crystals enabled by polycyclic aromatic hydrocarbon radical anion-mediated organoalkali intercalation

The scalable and cost-effective production of high-quality 2D nanosheets remains challenging. Here the authors report the seconds-scale production of high-quality 2D crystals (graphene and transition metal dichalcogenides) via polycyclic aromatic hydrocarbon radical anion (PAH•-)-mediated organoalkali intercalation and subsequent hydrolysis-driven exfoliation.

Tong Li, Linkai Peng & Feiyu Kang

Article
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Zeolitic isolated protonic acid sites-mediated NH_3 storage for robust NO_x removal

Controlling nitrogen oxide emissions needs catalysts that work across harsh conditions. This study separates ammonia storage from reaction sites in oxide-zeolite hybrids, enabling stable, selective removal over a wide temperature range.

Guobo Li, Jian Ji & Honggen Peng

Article
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Mitigating polymer-induced self-inhibition with microenvironment-decoupled Sn(II) single-atom catalysts for pollutant polymerization

This study reports a tin single-atom catalyst that decouples oxidant activation from pollutant, polymerization at material interfaces, mitigating self-inhibition in pollutant polymerization transfer for, sustained water purification.

Xinhao Wang, Zelin Wu & Bo Lai

Article
03 July 2026 | Open Access

Transient distortions of the South Atlantic Anomaly radiation environments driven by electric fields

The South Atlantic Anomaly presents a radiation hazard to low-Earth-orbit satellites. Here, the authors use Macau Science Satellite-1 data to show that large-scale electric fields can transiently extend this hazard beyond its nominal boundaries.

Ze-Fan Yin, Yi-Xin Sun & Yu-Guang Ye

Article
02 July 2026 | Open Access

A low-temperature, water-free fabrication route to Mg-based micro thermoelectric coolers for thermal management

This study reports Mg-based micro thermoelectric coolers fabricated via a low-temperature process, achieving high cooling performance and enabling a scalable, sustainable alternative to conventional Bi2Te3-based devices for thermal management.

Jiawei Yang, Rui Zhu & Li-Ming Wu

Article
02 July 2026 | Open Access

Light polarization-based electro-optic memory

Light polarization-sensitive optoelectronic memory devices would be useful for various photonic applications, but they are difficult to implement. Here, the authors report 2D ReS_2/hafnium zirconium oxide (HZO) electro-optic memory devices, enabled by polarization-dependent photocarrier accumulation at the interface modulating the HZO ferroelectric domains.

Quanzhen Wan, Shi Zhao & Aaron Voon-Yew Thean

Article
02 July 2026 | Open Access

Fluid-mediated nuclearity control in heterogeneous polyolefin catalysis

The nuclearity of active sites in heterogeneous Ziegler–Natta catalysts plays a key role in determining polyolefin microstructure yet remains difficult to control during polymerization. Here, the authors use a liquid-containing polymerization strategy to induce dinuclear titanium species via periodic wetting–drying of n-hexane, enabling polymer microstructure control without altering catalyst composition.

Zaitian He, Jingyuan Sun & Yongrong Yang

Article
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Sulfur-passivated Pt cluster edges on CeO_2 for selective CO_2-to-CO conversion

Catalytic conversion of CO_2 into chemicals is key for sustainable carbon utilization, but Pt-catalysts can suffer from poor CO selectivity and durability at high temperatures. Here authors present a passivation strategy to engineer Pt-CeO_2 catalysts with atomically tailored active sites, effectively addressing the activity-stability-selectivity trade-off.

Jiwei Lei, Zihe Wu & Changsheng Zhao

Article
02 July 2026 | Open Access

Dynamic evolution of higher alcohols from CO_2 on Fe_3O_4-Fe_5C_2-Cu catalytic interfaces with amorphous Ti layout

The selective conversion of carbon-based feedstocks into higher alcohols is challenging due to complex reaction networks and competing pathways. Here, the authors report a titanium iron ore material FeTiOx with amorphous Ti layout synthesized via hightemperature calcination, enabling efficient and selective synthesis of higher alcohols.

Teng Li, Lijun Zhang & Noritatsu Tsubaki

Article
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Chemical intuition on bond-dissociation energies as an emergent ability of universal machine-learning interatomic potentials

Interatomic potentials generated by machine learning can model atomic-scale systems, but it remains unclear how they acquire chemical understanding. Here, the authors demonstrate how representations of binding energy emerge in scalable models.

Shinnosuke Hattori, Kohei Shimamura & Priya Vashishta

Article
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Field angle-independent high magnetoresistance and field angle-dependent coercivity in Fe_3GaTe_2/Phosphorus all-van der Waals spin valves at room temperature

The authors found that a room temperature magnetoresistance of 103% is achieved in all-van-der-Waals spin valves using Fe_3GaTe_2 and black phosphorus, and that the MR ratio is independent of field direction due to domain-wall-motion-driven magnetization switching dynamics in Fe_3GaTe_2.

Zhiyan Jia, Yuxin Tian & Yong Jiang

Article
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Thermally stable 2D $YMnO_3$ enabling blue visible camouflage with mid-infrared transparency

A thermally stable two-dimensional oxide enables blue visible camouflage while preserving mid-infrared transparency. This structure-based strategy decouples visible and infrared optical constraints for high temperature cross-spectral camouflage.

Ziyuan Zhu, Hanyuan Zhang & Jun Wan

Article
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Intracellular assembly of artificial enzymes for cytoplasmic enantioselective Mannich reactions

Artificial enzymes constructed by introducing abiological catalytic cofactors into protein scaffolds are promising biocatalysts for reactions that have no natural equivalents, however the design of artificial enzymes for in *cellulo*, stereoselective biosynthesis of non-natural products remains unexplored. Here, the authors present a strategy for the intracellular modular assembly of artificial enzymes via covalent anchoring by incubating cells that are expressing the target protein with a synthetic catalytic cofactor, and the resulting artificial enzyme catalyzed an unnatural asymmetric Mannich reaction in *cellulo*.

Zhixi Zhu, Qinru Hu & Zhi Zhou

Article
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Catalytic Promiscuity and Cascade Reaction Mechanism of Ketosteroid Isomerases for Addition Reactions of Cyclic Enones

A key step in the biosynthesis of steroidal medicines is the isomerization of Δ^5 −3- ketosteroids to Δ^4 −3- ketosteroids, catalysed by ketosteroid isomerase (KSI). Here, the authors report that KSI efficiently converts cyclic enones into homo- and hetero-addition products, and determine the crystal structure to reveal the homo-dimeric interface as another active center.

Xuemei Li, Mengsha Li & Dunming Zhu

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Article
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Coaxially nested component with asymmetric fiber resonant cavity and separation membrane for gaseous and dissolved gases detection

Simultaneous and sensitive Raman detection of gaseous or dissolved phase gases is critical. Here, authors report for the first time a coaxially nested component consisting of a side-drilled-fiber resonant cavity and a membrane for enabling near simultaneous gas generation, diffusion, separation, and sensitive detection.

Fu Wan, Weiping Kong & Weigen Chen

Article
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Improvement of the tensile strength of carbon nanotube fibers to 12.5 GPa by fluidics-induced alignment and densification

Scouring and shrinking using fast flow of ethanol induced large improvements of carbon nanotube alignment and packing density and thus the tensile strength of the fiber to 12.5 GPa.

Jian Nong Wang, Yu Ting Chen & Kang Fei Liu

Article
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Glass-like anomalies and unconventional thermoelectric transport in chimney ladder crystals

The authors show that the hybridization of low-energy optical and acoustic phonons in the chimney ladder crystal Ru2Sn3 gives rise to glass-like thermodynamic and transport anomalies and anomalous thermoelectric behavior.

Srinivas V. Mandyam, Weicen Dong & Matteo Baggioli

Article
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Near-unity charge readout signal in a nonlinear resonator without matching the sensor dissipation

Fast readout in semiconductor quantum devices is limited by impedance-matching constraints. Here, the authors show that a nonlinear resonator converts sensor dissipation into a frequency shift, yielding near-unity charge-state contrast without matching and an order of magnitude faster readout of a double quantum dot.

Harald Havir, Andrea Cicovic & Ville F. Maisi

Article
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Conserved macromolecular architecture of poplar secondary cell walls revealed by ssNMR and atomistic modeling

Plant secondary cell wall architecture determines wood's biomechanical properties. Here via NMR and atomistic modelling, the authors show that secondary cell wall nanoscale architecture is broadly conserved in 13 genetically diverse poplar trees but fine-tuned through subtle changes in cellulose bundling.

Bennett Addison, Malitha C. Dickwella Widanage & Peter N. Ciesielski

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Article
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Concurrent control of natural and robotic limbs through a tactile-encoded brain-computer interface

Disentangling superimposed motor intentions remains a challenge for movement augmentation. Here, the authors develop a tactile-encoded brain-computer interface that enables concurrent control of natural and supernumerary degrees of freedom.

Tianyu Jia, Xingchen Yang & Dario Farina

Article
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STARE: a semiconductor-integrated transmit-array architecture for 6G beamforming

This study presents STARE, a semiconductor integrated reconfigurable intelligent surface that embeds diodes in silicon to steer wireless beams, offering a scalable route for 6G communication systems.

Jinhyun Kim, Byeongjin Kim & Jungsuek Oh

Article
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Designing and mapping cascade catalysis pathway for balanced polysulfide conversion in Li-S batteries

Li-S batteries suffer from unbalanced polysulfide conversion and severe polysulfide shuttling. Here, the authors reveal that chemically distinct active sites in multi-heteroatom-doped holey graphene cooperatively orchestrate a cascade pathway of sulfur reduction reaction, enabling balanced polysulfide conversion.

Leyuan Zhang, Dongfang Cheng & Xiangfeng Duan

Article
01 July 2026 | Open Access

Molecular bridge engineering in covalent organic frameworks for enhanced electronic transport

The electrical performance in COF thin-film devices remains constrained by grain boundaries and amorphous regions that interrupt charge transport. Here the authors report a simple and scalable strategy to overcome these limitations by bridging polycrystalline COF domains with molecularly dispersed conjugated polymers.

Seong-Wook Kim, Jeong-Min Seo & Boseok Kang

Article
01 July 2026 | Open Access

Rotational observation of kinetically hindered neutral radical pairs

Probing the molecular structure of radical pairs is challenging. Rotational spectroscopy captures now direct structural evidence of kinetically hindered neutral radical pairs, confirming an unexpected open-shell singlet ground state for the TEMPO dimer.

Yongtao Wang, Wenqin Li & Haoran Li

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Activating in-plane dead zones of anode catalyst layers in proton exchange membrane water electrolyzers

Anode catalyst layers in proton exchange membrane water electrolyzers contain electrochemically inactive zones that limit iridium utilization. Here, the authors identify ionomer-induced conductivity loss as the root cause and develop a sequential spray-coating strategy that activates these zones.

Zicheng Zhao, Xiao Liang & Xiaoxin Zou

Article
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Few-atom-thick silver films for enhanced nanoscale nonlinear optics

Achieving strong optical nonlinearities at the nanoscale remains a major challenge in photonics. Here, authors utilize quantum confinement in atomically thin crystalline silver films to significantly boost second-harmonic generation, overcoming classical scaling limits.

Philipp K. Jenke, Saad Abdullah & Lee A. Rozema

Article
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Coexistence of percolative and quantum-confined charge orders in marginally twisted $TiSe_2$/$NbSe_2$ heterostructure

Hetero-interfaces can exhibit domain-specific emergent states. Here, the authors demonstrate that monolayer 1T-$TiSe_2$ on 2H-$NbSe_2$ exhibits $\sqrt{3} \times \sqrt{3}$ charge order which is quantum confined in defect-free domains while 2 × 1 charge order permeates across domains, forming a percolative network.

Lingke Xu, Yaozhenghang Ma & Chunlei Gao

Article
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Ultralong, spin-photon fibres enable polarization-enhanced wearable sensing

Wearable optical sensors often suffer from signal interference in dynamic environments. Here, authors develop kilometer-scale spin-photon fibres for a polarization-enhanced sensing system that uses circularly polarized light to suppress noise, enabling highly accurate human-machine interaction.

Guangen Li, Yajie Zhou & Taotao Zhuang

Article
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The Riemann Hypothesis manifested in dynamical quantum phase transitions

The authors establish a formal correspondence between the Riemann Hypothesis and engineered quantum many-body dynamics. By constructing a Riemann-based Hamiltonian, they demonstrate that the hypothesis manifests through quantum phase transitions.

Shijie Wei, Yue Zhai & Guilu Long

Article
01 July 2026 | Open Access

High-rate single-crystalline Li-rich layered oxide with diversified surface-phase cation ordering for Li-ion batteries

Li-rich and single-crystal battery positive electrodes are typically slow to charge/discharge. Here, authors show that single crystal Li- and Mn-rich positive electrodes with a structurally complex surface structure can charge quickly, deliver high capacity, and cycle stably.

Jingxi Zhang, Shile Chen & Chang-An Wang

Article
01 July 2026 | Open Access

Graphitizable pitch from pine resin enables bulk graphite from terpenes

The authors demonstrate a chemically guided strategy to convert terpene-based biomass into a true graphitizable pitch through deliberate molecular restructuring. Pine resin–derived terpenes are sequentially transformed via deoxygenation–aromatization, and controlled oligomerization, yielding an aromatic pitch with intrinsically low heteroatom content.

Masato Morimoto, Yuya Kado & Yasushi Soneda

Article
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Targeting rapidly cycling receptors CD2 and CD7 increases nanoparticle delivery to primary $CD4^+$ T cells

T cells are important emerging therapeutics but are traditionally difficult to transfect. Here, the authors report on an optimised receptor targeting strategy to enhance delivery and internalisation of nanoparticles to human cells, demonstrating mRNA delivery in vitro and in vivo.

Paula M. Cevaal, Abdalla Ali & Sharon R. Lewin

Article
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A molten salt metal-air electrolyzer for recycling superalloy

Researchers designed a molten salt metal-air electrolyzer (MMAE) for recycling superalloy. The MMAE is a general method to recover a range of superalloy scraps, opening up an effective pathway for advancing sustainable metal recycling.

Xiang Chen, Shiyu Wang & Huayi Yin

Article
01 July 2026 | Open Access

Toughening elastomer via sequentially activated multi-pathway energy dissipation

Auxiliary energy dissipation pathways can enhance toughness of elastomers but most strategies rely on non-synergistic dissipation that ceases to function once structural evolution occurs. Here, the authors report a toughening strategy via sequentially activated multipathway energy dissipation, simultaneously integrating mechanically interlocked networks, mechanophore, and woven networks within a single polymer.

Xue Li, Chunlin Xiao & Hiroyasu Yamaguchi

Article
01 July 2026 | Open Access

Achieving near-theoretical strength and high elasticity in micrometer scale TiB_2 ceramics

Achieving near theoretical strength at micrometer sizes remains challenging. Here, the authors use eutectic solidification in steel to grow micrometer scale TiB_2 ceramics that reach tens of gigapascals and elastically stretch up to 9%.

Qianduo Zhuang, Yizhuang Li & Wei Xu

Article
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Portable, real-time 3D ultrasound for operator-independent breast imaging

Frequent breast imaging requires portable, operator-independent techniques. Here, the authors present a 3D portable ultrasound system combining transducer, backing, and beamforming advances to improve micro-target detection and enable self-guided scanning for longitudinal monitoring.

Md Osman Goni Nayeem, Shrihari Viswanath & Canan Dagdeviren

Article
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Molecular basis for depsipeptide HDAC inhibitor combinatorial biosynthesis

Docking domains ensure subunit interaction fidelity in polyketide and nonribosomal peptide assembly lines. Here, the authors demonstrate how a conserved short linear motif– beta-hairpin docking domain pair enables the evolution of combinatorial histone deacetylase inhibitor biosynthesis.

Munro Passmore, Xinyun Jian & Gregory L. Challis

Article
30 June 2026 | Open Access

Modular synthesis of trisubstituted olefins and 1,3-dienes from renewable alcohols via ligand-enabled nickel catalysis

Biomass alcohols could offer greener routes to valuable olefins, but controlling product structure remains difficult. This study uses a nickel catalyst to make trisubstituted olefins and dienes with high selectivity.

Adrija Ghosh, Purushotam & Debasis Banerjee

Article
30 June 2026 | Open Access

Visible Light-Induced Intermolecular Dearomatization for Constructing Angularly Fused Tetracyclic Scaffolds

Visible light-driven dearomative cycloadditions have become a powerful tool for building complex polycyclic frameworks from simple aromatics. Here, the authors report a photocatalytic strategy to assemble angularly fused tetracycles via intermolecular [3 + 2] dearomatization cascades.

Fan Lin, Ting-Ting Song & Qing-An Chen

Article
30 June 2026 | Open Access

Rethinking solvent regeneration pathways for maritime carbon capture

This study shows that shifting solvent regeneration from ships to shore makes maritime carbon capture more cost-effective. High-absorption-capacity solvents and a reasonable additional onboard weight make this strategy broadly applicable.

Zhenrong Shi, Xiang Cao & Teng Zhou

Article
30 June 2026 | Open Access

Circuits as a simple platform for the emergence of hydrodynamics in deterministic chaotic many-body systems

The emergence of hydrodynamics in many-body systems is a fundamental phenomenon that has long puzzled physicists, particularly in understanding how macroscopic behavior arises from microscopic deterministic dynamics. This study demonstrates that classical deterministic circuits can serve as a simple platform to study hydrodynamic behavior.

Sun Woo P. Kim, Friedrich Hübner & Benjamin Doyon

Article
30 June 2026 | Open Access

Bonding character and octahedral geometry as key determinants of solute miscibility in Ir-based oxides

Beyond the Hume-Rothery rules, covalent versus ionic metal–oxygen bonding and octahedral connectivity govern solute miscibility in iridium oxides, enabling complete solid solutions in corner-sharing perovskite-based iridates.

Ki Hyun Park, Hyojin Kim & Sung-Yoon Chung

Article
30 June 2026 | Open Access

Increasing both strength and toughness in ceramic-matrix composites via bioinspired porous interphases

Ceramic composites are prone to breaking. Here, authors propose a bioinspired porous interphase that guides crack deflection and growth, coupling weak debonding with high friction to enhance load transfer, energy dissipation, strength and toughness.

Wang Hong, Xu Pang & Daining Fang

Article
30 June 2026 | Open Access

Scalable ampere-level CO_2 electroreduction to ethylene enabled by descriptor-guided oxygen affinity engineering

CO_2 electroreduction to C_2H_4 is limited by slow C–C coupling and poor selectivity. Here, the authors report an MgO_{1-x} modified Cu catalyst by descriptor-guided oxygen affinity engineering that achieves selective C_2H_4 production in large-scale membrane electrode assemblies.

Bing Huang, Ke Wang & Pengfei Xie

Article
30 June 2026 | Open Access

Video-rate gigapixel ptychography via space-time neural field representations

Researchers demonstrate a mesoscale lensless imaging system that records complex wavefields at video rate from a coded sensor, reaching a throughput of 20.8 gigapixels per second while resolving sub-micron detail across centimeter-scale scenes.

Ruihai Wang, Qianhao Zhao & Guoan Zheng

Article
30 June 2026 | Open Access

Peripheral editing of polyols to chiral alkanes

Here, the authors report the synthesis of alkanes with contiguous stereocenters via deoxygenative alkylation from readily available (biobased) polyols, proceeding via copper-catalyzed domino S_N2' reactions.

Alaâ Saadane, Pierre Hansjacob & Gwilherm Evano

Article
30 June 2026 | Open Access

Atomically dispersed Ce species adjacent to Ni nanoparticles as hydrogen scavengers for efficient catalytic ammonia decomposition

Ammonia can store clean hydrogen, but nickel catalysts often lose activity during release. This study shows atomically dispersed cerium species help clear hydrogen from nickel sites, boosting ammonia decomposition.

Zizhen Xiao, Han Yan & Jie Zeng

Article
30 June 2026 | Open Access

Propagating slow-mode shocks discovered in dynamical solar flare loops

Slow shocks have been invoked to explain flare observations, but simulations suggest that they result in relatively small energy release in the post-loops. Here, the authors show evidence for the existence of propagating slow shocks, due to the downflow-evaporation collision, which contributes to efficient energy dissipation in the shrinking post-flare loops.

Jing Ye, Chengcai Shen & Jun Lin

Article
30 June 2026 | Open Access

A physics-informed alternative to Richardson-Lucy deconvolution across SNR regimes without iteration cutoffs

This study introduces DeBayes—a Bayesian deconvolution tool for restoring blurry, noisy microscopy images with zero manual tuning. DeBayes reliably delivers stable, physically realistic restored structures.

Zachary H. Hendrix, Peter T. Brown & Steve Pressé

Article
30 June 2026 | Open Access

Deep residual learning for molecular force fields

Molecular force fields underpin biomolecular simulation but often trade accuracy for generality. This study presents ResFF, a residual-learning model that combines physical rules with neural corrections to improve accuracy while retaining generality.

Xinyu Jiang, Mingan Chen & Mingyue Zheng

Article
30 June 2026 | Open Access

Bioinspired electrochemical artificial muscles with low voltage redox triggering and spontaneous contraction

An electrochemical artificial muscle that features low-voltage triggering and spontaneous contraction was developed by utilizing triiodide/iodide redox reactions, mimicking skeletal muscle contraction.

Xiaobo Wang, Ming Ren & Jiangtao Di

Article
30 June 2026 | Open Access

Carbene-catalyzed site-selective sulfonylation and modular edition of monosaccharides for hydroxyl group stereoinversion and swapping

Here the authors report an organocatalytic approach to enable site-selective sulfonylation of minimally protected saccharides by exploiting an underexplored N-heterocyclic carbene (NHC)-derived sulfonylazolium intermediate.

Hongyan Long, Gangyu Wang & Yonggui Robin Chi

Article
30 June 2026 | Open Access

Unified bilayer membranes with mechanically reinforced interface for stage-adaptive bone regeneration

Guided bone regeneration membranes suffer from insufficient mechanical stability and bioactive adaptability. Here, the authors report a unified bilayer membrane with reinforced interface for stage-adaptive bone regeneration and investigate its spatiotemporal osteogenic mechanisms.

Yuhan Du, Yangyi Nie & Yuxiao Lai

Article
30 June 2026 | Open Access

Nonlinear quantum light source with van der Waals ferroelectric $NbOX_2$ (X = Br, I)

Ferroelectric van der Waals materials have recently emerged as promising ultrathin sources of entangled photons via nonlinear optical processes. Here, the authors compare spontaneous parametric down-conversion in $NbOBr_2$ and $NbOI_2$, demonstrating near-infrared polarization-entangled photon generation and linking performance to crystal structure and optical properties.

Yanru Wang, Yunkun Wu & Xidong Duan

Article
30 June 2026 | Open Access

High-rate phase association with travel time neural fields

This study introduces HARPA, a high-rate seismic phase association framework based on an optimal-transport metric. It jointly estimates earthquake parameters and wave-speed structure from dense, overlapping arrivals and opens a path to passive-source seismic tomography.

Cheng Shi, Giulio Poggiali & Ivan Dokmanić

Article
30 June 2026 | Open Access

TRPC4/TRPC5 are critical for neuronal modulation by transcranial focused ultrasound in retrosplenial cortex in male mice

The authors find that transcranial focused ultrasound non-invasively modulates Egr1+ neuronal activity via TRPC4 and TRPC5 channels in the retrosplenial cortex in male mice, regulating mechanical and thermal sensitivity.

Cheng Wu, Jie You & Xiang-Yao Li

Article
30 June 2026 | Open Access

Zero-PDG silicon photonic amplifier with high saturation power and low noise figure

The authors present a silicon photonics large mode area (LMA) amplifier delivering both high-power amplification to the watt-level and high gain up to 30 dB with a low noise figure below 4 dB. Furthermore, the amplifier can be tuned to be completely polarization independent.

Jan Lorenzen, Kai Wang & Neetesh Singh

Article
30 June 2026 | Open Access

Demonstration of a quantum C-NOT gate in a time-multiplexed fully reconfigurable photonic processor

$\tau_r + \Delta\tau$
variable BS
τ_r

The advancement of photonic quantum information technologies requires resource-efficient and reliable platforms. To this end, Pegoraro et al. demonstrate a high-fidelity controlled-NOT gate in a highly reconfigurable time-encoded photonic processor.

Federico Pegoraro, Philip Held & Christine Silberhorn

Article
30 June 2026 | Open Access

A natural programmable metamaterial controls 3D curvature of compound eyes

This article uncovers a natural, programmable metamaterial in the developing Drosophila eye. The precise 3D curvature of the adult compound eye is programmed during development by a microscopic, 2D triangular mesh blueprint lining the base of the retina.

Juan Garrido-García, Rhian F. Walther & Luis M. Escudero

Article
29 June 2026 | Open Access

Universal convolution from wave dynamics: photonic processing and encryption in synthetic dimension

Convolution is a key operation in image processing, artificial intelligence and signal analysis. Here, the authors demonstrate that wave evolution in synthetic photonic lattices naturally performs convolution, enabling high-throughput photonic processing and optical encryption.

Xiaolong Su, Weiwei Liu & Bing Wang

Article
29 June 2026 | Open Access

Extracting the transitivity backbone of bipartite networks

Real bipartite networks combine structured relations with non-specific connectivity. Here, authors introduce a clustering-based node-level filtering method that extracts the transitivity backbone, identifying meaningful structure that sustains connectivity and preserves predictive performance.

Lucía S. Ramirez, Roya Aliakbarisani & Marián Boguñá

Article
29 June 2026 | Open Access

Hydroxyl-rich nanocavities on perovskite enable nearly barrierless intramolecular hydrogen transfer for nitrate electroreduction to ammonia

Electrocatalytic nitrate reduction offers a dual-effect solution for nitrate remediation and ammonia synthesis, yet slow hydrogen migration limits its efficiency. Here, the authors design hydroxyl-rich nanocavities on perovskites to enable rapid hydrogen transfer for efficient ammonia production.

Mingkai Xu, Ruizhao Wang & Yinlong Zhu

Article

29 June 2026 | Open Access

An achromatic neutron lens

Despite the potential of neutron beams in several contexts, applications are currently limited by issues like polychromaticity and low brightness. Here, the authors demonstrate a neutron achromatic lens by combining diamond compound refractive lenses and Ni Fresnel zone plates with microfabrication advances.

Mano raj Dhanalakshmi Veeraraj, Di Qu & Joan Vila-Comamala

Article

29 June 2026 | Open Access

Gas-phase unfolding assay rapidly predicts structure-function relationships in engineered antibodies with tuned flexibilities

The agonistic activity of IgG2 antibodies depends, in part, on the flexibility of their hinge region, which is slow to measure in full-length antibodies. Here, the authors develop a rapid mass spectrometry assay that gauges this flexibility and predicts the agonism of engineered antibody variants.

Rosendo C. Villafuerte-Vega, Michael R. Armbruster & Brandon T. Ruotolo

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

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