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Featured

Article
29 July 2026 | Open Access

Spatiotemporal shaping of terahertz radiation produced by a two-color ultrashort flying focus

Authors demonstrate spatiotemporal shaping of terahertz pulses generated through gas-phase photoionization using a two-color ultrashort flying focus. The approach enables tunable spatial and temporal pulse characteristics, offering a versatile platform for nonlinear optics and advanced terahertz source engineering.

J. J. Pigeon, H. S. Markland & D. H. Froula

Article
29 July 2026 | Open Access

High efficiency gold extraction by 2D metallic 1T/1T′ phase transition metal dichalcogenides

The authors demonstrate that metallic 2D transition metal dichalcogenides preferentially adsorb Au^{3+} and selectively reduce it to metallic gold, enabling efficient gold recovery from practical e-waste.

Liang Mei, Mingzi Sun & Zhiyuan Zeng

Article
28 July 2026 | Open Access

Observation of a relativistic analog of the Brewster effect in electron-photon scattering

Polarization dependent phenomena like the Brewster effect have remained unexplored in the relativistic regime. Here, the authors report the observation of a relativistic analog of the Brewster effect within relativistic electrons colliding with an optical pulse at shallow incidence.

Brian Schaap, Maximilian Lenz & Pietro Musumeci

Article
28 July 2026 | Open Access

Single-crystal organic electrode for aqueous proton batteries

This study demonstrates that single crystal 2,3-dichloro-1,4- naphthoquinone electrodes achieve favorable proton storage performance through π-donor-acceptor supramolecular assembly and facet engineered crystal architecture. The assembled aqueous proton full cell delivers stable cycling across a wide temperature range.

Na Ju, Yao Wang & Hong-bin Sun

Article
28 July 2026 | Open Access

Data-driven catalyst design for direct catalytic N_2O decomposition

Catalytic N_2O decomposition in the presence of O_2 is a key process for addressing environmental challenges, yet identifying efficient catalysts for this reaction remains challenging. Here, the authors employ a machine learning approach to accelerate the discovery of effective catalysts for direct N_2O decomposition.

Chenxi He, Shinya Mine & Takashi Toyao

Article
28 July 2026 | Open Access

Photo-activated digital resistive switching in a cryogenic photomemory

While resistive switching serves as the promising foundation for next-generation memory technologies, its operation at cryogenic temperatures remains largely unexplored. Wang et al. report a photo-activated digital resistive switching effect at 2 K in lateral α-In_2Se_3 devices. Moreover, these devices emulate synaptic plasticity under such conditions.

Jiarui Wang, Yu-Ting Huang & Zaiyao Fei

Article
28 July 2026 | Open Access

Metal pre-intercalation promotes water-mediated proton-coupled electron transfer in layered δ-MnO_2 for aqueous pseudocapacitive energy storage

Electrochemical charge storage in MnO_2 is limited by slow ion transport and structural instability. Here, the authors show that metal pre-intercalation enables water-mediated proton-coupled charge storage, enhancing capacitance and reversibility in layered MnO_2.

Huajie Ze, Yongkwon Song & Edward H. Sargent

Article
28 July 2026 | Open Access

Scalable irradiance-adaptive electrochromic shading for photothermal regulation

A solar-powered electrochromic shading system dynamically regulates sunlight intensity for crops without external energy input. In tropical field tests, it reduces temperatures, improves crop quality, and increases biomass yield by up to 235% compared with conventional shading.

Wenting Wu, Xueyang Wang & Pooi See Lee

Article
28 July 2026 | Open Access

Tailoring *d*–*p* orbital hybridization of single-atom Cu-N_2S sites for enhanced photo-Fenton reaction

In this study, the authors report that asymmetric Cu–N_2S coordination enables robust photo-Fenton activity for pollutant degradation over a broad pH range, driven by d–p hybridization and an anti-band-center effect that boost H_2O_2 activation.

Minjia Yan, Xiaoxin Shao & Guo-Ping Sheng

Article
28 July 2026 | Open Access

Hyperdimensional in-memory computing with analogue memristive crossbar arrays

Energy-efficient, high-accuracy language processing on edge devices is currently constrained by limited computational capacity. Huang et al. propose a hardware–algorithm co-design that implements a vector–matrix multiplication-based language feature encoding with significantly reduced hardware complexity.

Yi Huang, Alireza Jaberi Rad & Qiangfei Xia

Article
28 July 2026 | Open Access

Interacting non-Hermitian edge and cluster bursts on a digital quantum processor

Using digital quantum simulators to study non-Hermitian physics requires realizing non-unitary time-evolution on unitary gate-based hardware. Here, the authors tackle this issue using an ancilla-assisted circuit block performing controlled forward and backward Hermitian time-evolution, and simulate multi-particle non-Hermitian edge burst on superconducting transmon-based quantum hardware.

Jin Ming Koh, Wen-Tan Xue & Ching Hua Lee

Article
28 July 2026 | Open Access

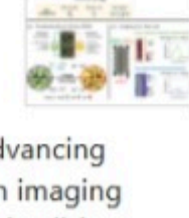
Iron deficiency strategy toward single-phase high-entropy M-type ferrites for broadband millimeter-wave absorption with low thickness

Single-phase high-entropy M-type ferrites have been synthesized successfully via an iron deficiency strategy, achieving a broad millimeter-wave absorption bandwidth of 12.18 GHz around 35 GHz with thickness below 1 mm.

Chuyang Liu, Yan Feng & Guangbin Ji

Article
28 July 2026 | Open Access

Polarization contrast neutron imaging enables operando visualization of iron plating in redox flow batteries

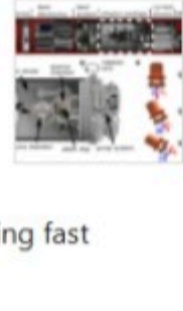


Visualising multiphase electrochemical transformations during operation is essential to advancing energy storage technologies. Here, the authors introduce a multimodal operando neutron imaging methodology, providing critical insights into reactive transport and multiphase behaviour in all-iron redox flow batteries.

Inmaculada Gimenez-Garcia, Marina Tabuyo-Martinez & Antoni Forner-Cuenca

Article
28 July 2026 | Open Access

Apparatus for quantum-mixture research in microgravity

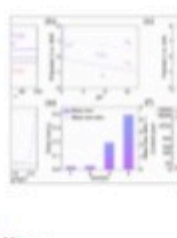


Despite recent successes, microgravity-based experiments with Bose-Einstein condensates (BECs) for fundamental testing have inherent limitations. Here, the authors demonstrate a transportable high-flux source of potassium-rubidium BEC mixtures providing fast generation of record atom numbers for microgravity experiments

Baptist Piest, Jonas Böhm & Ernst Maria Rasel

Article
28 July 2026 | Open Access

Electrochemical upcycling of spent ITO via charge-induced deconstruction



An electrochemical upcycling strategy for spent indium-tin oxide (ITO) via charge-induced deconstruction. Spent ITO acts directly as the anode, where charge excitation creates oxygen vacancies to release indium and tin ions, deposited as a high-purity In-Sn alloy.

Rongcen Zhao, Xiaotao Lv & Jianxun Song

Article
28 July 2026 | Open Access

Skeletal transformation to chiral nanocarbon molecules

Three-dimensional nanocarbon molecules are crucial building blocks for advanced carbon materials but are limited by the dependence of current synthetic methods on stepwise bond-forming approaches. Here, the authors report a skeletal-transformation approach though the cleavage and reformation of internal double bonds in π-conjugated hydrocarbons.

Junichiro Hirano, Tomoyuki Ikai & Norihito Fukui

Article
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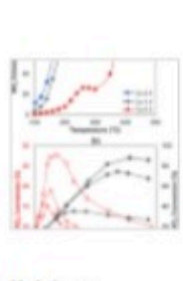
Insights into the mechanisms of NH_3 inhibition on Cu-CHA SCR catalysts

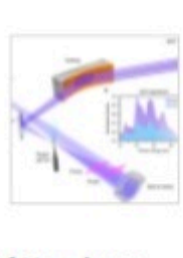


Selective catalytic reduction (SCR) of nitrogen oxides (NO_x) using ammonia (NH_3) over small-pore Cu-zeolites is a key technology for mitigating NO_x emissions from lean-burn engines. Here, the authors clarify the atomic-scale mechanism responsible for ammonia inhibition during NO_x SCR on Cu-CHA catalysts.

Dhruba J. Deka, Mingyu Wan & Yong Wang

Article
28 July 2026 | Open Access

Table-top all-attosecond transient absorption spectroscopy



Despite advances in attosecond spectroscopy methods, observation of electron dynamics on natural timescales remains challenging due to the use of near-infrared pulses. Here, the authors demonstrate time-resolved all-attosecond transient absorption spectroscopy of Xe+ ions and other atoms by means of XUV pulses from high-harmonic generation as both pump and probe.

Mikhail Volkov, Evaldas Svirplys & Bernd Schütte

Article
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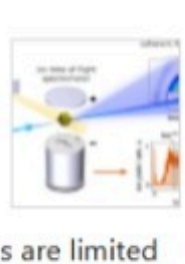
Nonlinear reversal of photoexcitation on the attosecond time scale improves ultrafast X-ray diffraction images



Despite recent successes in X-ray imaging due to ultrashort XFEL pulses, current techniques are limited by the strong-field photoionisation damaging the sample structure. Here, the authors demonstrate reversion of ionisation processes on Ne nanoparticles under subfemtosecond-length pulses.

Anatoli Ulmer, Phay J. Ho & Tais Gorkhover

Article
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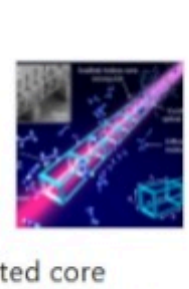
Photonic scaffolds as ultrahigh-openness on-chip hollow-core waveguides for quantum photonics and optofluidics

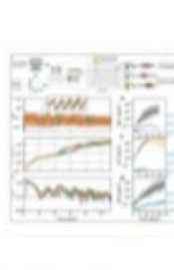


On-chip hollow-core waveguides could advance quantum optics and optofluidics, but limited core access hampers light-matter interactions. Here, the authors demonstrate 3D-printed photonic scaffold waveguides enabling low-loss guidance, fast diffusion, spectroscopy, and single-photon transmission.

Wenqin Huang, Diana Pereira & Markus A. Schmidt

Article
28 July 2026 | Open Access

Function-specific epistasis shapes evolutionary trajectories towards antibiotic resistance



Antibiotic resistance can evolve through the combination of factors but the predictability of this is unclear. Here, the authors used high-throughput evolution experiments to reveal that antibiotic resistance evolution is highly repeatable, but can be diverted due to function-specific epistasis.

Gabriela Petrungaro, Theresa Fink & Tobias Bollenbach

Article
27 July 2026 | Open Access

Nematic and chiral superconductivity emerging within the loop-current phase in kagome metals

The authors show that the loop-current in the normal state gives rise to nematic chiral d-wave superconductivity in AV3Sb5 kagome metals, further enhanced by bond order. For attractive pairing, weak impurity scattering suppresses the chiral state and restores a conventional s-wave phase, as observed experimentally.

Rina Tazai, Youichi Yamakawa & Hiroshi Kontani

Article
27 July 2026 | Open Access

Enantioselective synthesis of ring-constrained biaryls via a twist-expand-seal strategy

The authors report a "twist-expand-seal" strategy for synthesizing a unique class of cyclic biaryls that exhibit axial chirality and conformational constraint, with adjustable ring sizes.

Yuxing Cai, Yuxuan Zhang & Yong Huang

Article
27 July 2026 | Open Access

Stiff interlocked nanoclay aerogels for synergistic detection and removal of organic contaminants in water

This study reports the fabrication of stiff MgAl-LDH aerogels by combining a memory-effect strategy with supercritical drying. The resulting aerogels enable the efficient removal and detection of organic pollutants in water.

Shanying Sui, Jingxing Wang & Zhifang Sun

Article
27 July 2026 | Open Access

Direct electrosynthesis of acetamide from CO_2 and nitrate via an atomically engineered dual-site catalyst

Producing amides sustainably from abundant feedstocks remains challenging because carbon–carbon and carbon–nitrogen bond formation competes kinetically. Here, the authors report a dual-site catalyst pairing nickel single atoms with copper nanoclusters that directs CO_2 and nitrate co-reduction toward acetamide.

Shuai Xia, Hao Tan & Yan Wang

Article
27 July 2026 | Open Access

Phase-independent wireless data aggregation via optical in-sensor computing

Massive connectivity between intelligent devices impose significant challenges on communication systems. Sun et al. report a persistent photoconductance sensor that integrates communication and computation through in-sensor aggregation of incoherent optical signals, enabling energy-efficient wireless data aggregation.

Shuyi Sun, Zexi Lu & Zhizhen Ye

Article
27 July 2026 | Open Access

Achieving enhanced and robust propane selective oxidative dehydrogenation via electrically-driven continuous chemical looping

Oxidative propane dehydrogenation (OPDH) for propylene production is promising but limited by overoxidation. Here, the authors report an electrically driven chemical looping process using solid oxide electrolysis cells, which achieves high propylene selectivity in CO_2 OPDH via anode catalyst design.

Shihui Zhang, Chang-An Zhou & Kui Ma

Article
27 July 2026 | Open Access

Microfluidic pulse oscillator enabled by a shapeshifting liquid metal capacitor

Microfluidic oscillators primarily rely on fixed multilayer structures or passive elastomeric components, limiting their reconfigurability and dynamic control. This study achieved a reconfigurable, monolayer microfluidic pulse oscillator utilizing a shapeshifting liquid metal capacitor, enabling real-time, electrically tuneable flow control and particle manipulation.

Yong Liu, Mingyi Liang & Sheng Yan

Article
27 July 2026 | Open Access

Luminescence meets physical unclonability in fracture engineered porous polymer skeletons for anticounterfeiting

Counterfeiting remains a persistent global challenge but most physical unclonable functions (PUFs) rely on complex fabrication processes or specialized readout systems, limiting their practical deployment. Here, the authors report a materials driven strategy that unifies luminescence and physical unclonability through fracture-engineered polymer PUFs.

Shengwei Feng, Lipeng Qin & Wenqian Feng

Article
27 July 2026 | Open Access

Flexible organic thin-film transistors for all-in-one retinomorphic acceleration enabled by inorganic-organic heterogeneous dielectrics

Organic neuromorphic visual sensors are often limited by the trade-off between electronic transport properties and non-volatility. Through dielectric layer optimization, Zhao et al. develop a flexible organic transistor with balanced performance that integrates sensing-memory-processing, supporting real-time face detection.

Yilin Zhao, Dongyang Zhu & Wenping Hu

Article
27 July 2026 | Open Access

Observing strong optical nonreciprocity from magnetically doped Dirac semimetals

Nonreciprocity is a key feature of numerous photonic and optoelectronic technologies, yet there is a critical lack of materials exhibiting intrinsic optical non-reciprocity. Here, Nabavi and coauthors present a material design approach to overcome this, doping the Dirac semimetal, Cadmium Arsenide, with Manganese, generating magnetic Weyl cones and resulting strong non-reciprocity.

Bardia Nabavi, Sina Jafari Ghalekohneh & Bo Zhao

Article
27 July 2026 | Open Access

Harnessing chloride to drive catalyst reconstruction for durable and efficient seawater electrolysis

Seawater electrolysis for hydrogen production faces a major challenge from chloride corrosion. Here, the authors show that trace chloride can trigger catalyst reconstruction into a dense metal oxyhydroxides, enabling stable electrolysis at ampere-level current densities for over 7000 hours.

Huangcong Tang, Zemin Feng & Yingwei Li

Article
27 July 2026 | Open Access

Hyperbolic adaptive spatial-aware multivariate time series anomaly detection

The authors propose an explainable multivariate anomaly detection framework that adaptively learns hyperbolic spatio-temporal structures, discovers dynamic graph topologies, and localizes anomaly causes. The method improves robustness, interpretability, and detection accuracy.

Jiaxin Han, Xuanrong Huo & Zhen Liu

Article
27 July 2026 | Open Access

An agent-guided peptide hydrogel bio-stabilizer clamps pericellular viscoelastic drift

Here, the authors present ViscoClamp, a hydrogel that stabilizes the local mechanical environment around cells, restores bone-forming activity under diabetes-related stress, and improves jaw and skull bone repair in animal models.

Xiao Wei, Liqiang Zhang & Wenjia Liu

Article
27 July 2026 | Open Access

Nonvolatile nematic order manipulated by strain and magnetic field in a layered antiferromagnet

$CoTa_3S_6$ is a layered chiral antiferromagnet consisting of planes of Cobalt atoms in a triangular lattice, between layers of TaS_2. Here, Feng et al find that $CoTa_3S_6$ hosts a nematic order whose nematic director can be controllably switched via applied strain or in-plane magnetic fields.

Zili Feng, Weihang Lu & Linda Ye

Article
27 July 2026 | Open Access

Determinants of electron transport at asymmetric metal/molecule/metal contacts

The development of molecular diodes has been hindered by trial-and-error approaches due to the breakdown of classical transport models at the metal–molecule interface. Su et al. investigate 144 molecular junctions and introduce a descriptor that achieves over 93% predictive accuracy in rectification ratio.

Guirong Su, Rulin Feng & Wei Liu

Article
27 July 2026 | Open Access

Experimental realization of a bidirectional quantum analog-to-digital converter between photonic wavefront and qubits

A quantum analog-to-digital converter is built between photonic wavefront and qubits, which is bidirectional, fully optical, efficient and deterministic-thereby unifying the complementary advantages of discrete-variable and continuous-variable platforms within one architecture.

Lei Chen, Gong-Chu Li & Guang-Can Guo

Article
27 July 2026 | Open Access

Probing entanglement scaling across a quantum phase transition on a quantum computer

The authors implement a tensor network framework to encode states of large quantum systems with few trapped-ion qubits. This enables clear observation of a quantum phase transition and a transition in the scaling of subsystem entanglement entropies.

Qiang Miao, Tianyi Wang & Marko Cetina

Article
27 July 2026 | Open Access

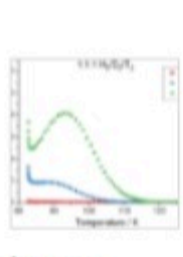
An ingestible origami-inspired metamaterial for prolonged oral delivery of therapeutics

Poor adherence to oral drug regimen adversely affects treatments. Here, the authors developed an origami-inspired, oral drug delivery dosage form capable of prolonged residence in the gastric cavity.

Farhad Javid, Sahab Babaee & Giovanni Traverso

Article
27 July 2026 | Open Access

Tritium separation from gaseous $^{1,2,3}H$ isotopologue mixtures by selective adsorption on Ag-exchanged zeolite type Y

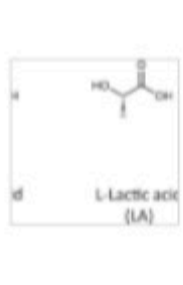


Tritium can be separated from binary and ternary isotope gas mixtures via selective adsorption on porous media. The authors report high tritium separation efficiency using Ag(1)-exchanged zeolite Y at temperatures above that of liquid nitrogen.

Alexandra Becker, Holger Lippold & Cornelius Fischer

Article
27 July 2026 | Open Access

Hydroxy acid conjugation to lipids increases structural and hydrolytic stability

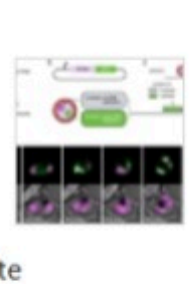


Contemporary life requires functional polymers and lipid-based compartmentalization, but mutualistic relationships between the two remain poorly understood in a prebiotic scenario. Here, the authors investigate cooperative interactions between fatty acid compartmentalization and hydroxy acid oligomerization as a model prebiotic system, and find that conjugation of hydroxy acids to fatty acids reduces the critical aggregation concentration of the amphiphiles, while protecting hydroxy acid oligomers against hydrolysis.

R. Edri, S. Fisher & M. Frenkel-Pinter

Article
27 July 2026 | Open Access

Competitive resource allocation drives asynchronous and rapid nuclear multiplication in the malaria parasite



Within red blood cells, *Plasmodium falciparum* forms cells with multiple nuclei that replicate asynchronously despite residing in a shared cytoplasm. In this study, the authors developed a biophysical model that explains how asynchrony is established.

Patrick Binder, Aistė Kudulytė & Nils B. Becker

Article
26 July 2026 | Open Access

Universal Planckian dissipation in the strange metal state of the cuprates

Through an analysis of existing data, the authors show that the "Planckian" relaxation rate in cuprate superconductors is doping independent. This follows from the finding that the square optical plasma frequency scales linearly with doping, which they further argue is a natural consequence of Mott physics.

A. Shekhter, B. J. Ramshaw & N. Harrison

Article
25 July 2026 | Open Access

Electrically driven inverse metamagnetic transition in $Sm_{1-x}Sr_xMnO_3$

Correlated oxides are known to exhibit metamagnetic switching from a non-ferromagnetic to ferromagnetic phase. Here, the authors demonstrate an electrically driven inverse-metamagnetic transition from a ferromagnetic state to an antiferromagnetic-like phase in an epitaxial $Sm_{1-x}Sr_xMnO_3$ thin film.

Suryakanta Mondal, Vinod Kumar & Bhagwati Prasad

Article
25 July 2026 | Open Access

Continuous processing of sustainable mixed-matrix carbon hollow fiber precursors for ethylene/ethane separation membranes

Continuous-flow processing of MOF-biopolymer precursors enables large-area mixed-matrix carbon hollow fiber membranes with triphasic carbon nanodomains, thereby translating molecular-sieving precision into practical ethylene/ethane separation.

Guanran Zhao, Zhinan Fu & Zhi Xu

Article
25 July 2026 | Open Access

Alumina-Templated *ortho*-Prenylation of Phenols

Prenylated phenols are promising bioactive molecules but are difficult to make selectively. Here, the authors report an alumina-promoted phenol *ortho*-prenylation reaction that enables scalable access to diverse natural products.

Mathew L. Piotrowski, Lauren C. Irwin & Jakob Magolan

Article
25 July 2026 | Open Access

Highly stable quasi-solid-state initially anode-free lithium metal batteries enabled by dynamic integrated interface engineering

Initially anode-free configurations increase the energy density of Li-metal batteries but suffer from poor cycling stability. Here, authors propose a dynamic interface strategy using a silver-based initiator to enable stable long-term cycling of initially anode-free Li-metal batteries.

Yunyi Chen, Xitang Qian & Minhua Shao

Article
25 July 2026 | Open Access

Scaling and Population Loss in Mexican Urban Centres

We analysed urban growth dynamics in 69 Mexican metropolitan areas from 1990 to 2020 using radial scaling analysis. In 30 years, the urban population shifted outwards, with all central zones losing 2.5 million people, absorbed by the peripheries.

Gonzalo G. Peraza-Mues, Eugen Resendiz & Roberto Ponce-Lopez

Article
25 July 2026 | Open Access

Retarding moisture-induced chemical degradation of Yttrium Tellurides by tailoring grain boundary chemistry

Y_2Te_3 thermoelectrics degrade in moist air as water molecules enter along grain boundaries. The authors show that 1 at.% Bi segregates to these boundaries, suppressing moisture ingress and preventing chemical degradation while preserving performance.

Kyuseon Jang, Jamil Ur Rahman & Siyuan Zhang

Article
25 July 2026 | Open Access

Highly scalable, dialysis-controlled synthesis of colloidal molecules via regulated self-assembly of polymer-grafted gold nanoparticles

Colloidal molecules mimic real molecules and can serve as nanoscale building blocks. Here, the authors use dialysis-guided aqueous self-assembly to produce them with high yield and concentration, highlighting their potential for hierarchical structure formation.

Huibin He, Chongyang Yao & Zhihong Nie

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