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Article
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Perovskite spin light-emitting diodes with simultaneously high electroluminescence dissymmetry and high external quantum efficiency

He et al. report spin-LEDs based on chiral perovskite quantum dots which act as localized spin-selective units and radiative recombination centers simultaneously. Ultrasonic treatment assisted ligand exchange enables spin-LEDs with peak efficiency of 16.8% and dissymmetry factor of 0.285.

Shuai He, Weixi Lin & Qinghai Song

Article
04 March 2025 | Open Access

Electronic structure of mononuclear and radical-bridged dinuclear cobalt(II) single-molecule magnets

Four-coordinate cobalt(II) complexes possess high energy barriers toward inversion of the magnetic moment, but not the magnetic bistability needed for magnetic data storage. Here, the authors report an air-stable radical-bridged binuclear cobalt(II) complex with improved magnetic properties.

David Hunger, Julia Netz & Joris van Slageren

Article
04 March 2025 | Open Access

Experimental consequences of disorder at an antiferromagnetic quantum phase transition

Studying the effect of disorder usually requires many samples with different levels of disorder, which is experimentally onerous. Here, Armstrong et al. make use of the natural isotopic variation of Er in $LiErF_4$ to study the influence of disorder on a quantum phase transition in the same sample.

S. L. Armstrong, D. M. Silevitch & T. F. Rosenbaum

Article
04 March 2025 | Open Access

Regulation of lanthanide supramolecular nanoreactors via a bimetallic cluster cutting strategy to boost aza-Darzens reactions

Supramolecular nanoreactor as artificial mimetic enzyme is attracting a growing interest due to fine-tuned cavity and host-guest molecular recognition. Here, the authors design 3d-4f metallo-supramolecular nanocages with different cavity sizes and active sites based on a bimetallic cluster cutting strategy as catalysts for the three-component aza-Darzens reaction.

Jingzhe Li, Manchang Kou & Weisheng Liu

Article
04 March 2025 | Open Access

Synthesis of highly effective polyester/polyacrylate compatibilizers using switchable polymerization

Multiblock copolymers (MBCPs) comprising polyester and polyacrylate segments offer an efficient strategy for enhancing the performance of polyester and polyolefin blends but synthesis and structural modification of these MBCPs remains challenging. Here, the authors propose a method for synthesizing MBCPs via the switchable polymerization of epoxides, cyclic anhydrides, and acrylates using a dinuclear Co-complex.

Xiang-Yu Fu, Tian-Jun Yue & Wei-Min Ren

Article
04 March 2025 | Open Access

Tailoring asymmetric RuCu dual-atom electrocatalyst toward ammonia synthesis from nitrate

Nitrate electroreduction to ammonia offers a sustainable route, but designing efficient catalysts remains challenging. Here, the authors develop a pulsed discharge strategy to synthesize dual atom catalysts with asymmetric active sites, achieving high ammonia production efficiency and stability.

Kaiyuan Liu, Zhiyi Sun & Pengwan Chen

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Selective transformation of propargylic ester towards tunable polymerization pathways

Selective transformation of the same monomer into diverse polymers by modulating the polymerization conditions remains a synthetic challenge. Here, the authors report the design of propargylic ester, which can be selectively transformed into polyimidate, polyimine, or polyamidine through distinct polymerization pathways.

Haiyan Hu, Xuelun Duan & Nan Zheng

Article
04 March 2025 | Open Access

LNP-RNA-mediated antigen presentation leverages SARS-CoV-2-specific immunity for cancer treatment

Immunoengineering-based cancer therapies have huge potential. Here the authors report on the lipid nanoparticle delivery, to cancer cells, of self-amplifying RNA encoding SARS-CoV-2 spike epitope-loaded MHC I molecules to take advantage of anti-SARS-CoV-2 immunity from a vaccinated population to treat cancer.

Yonger Xue, Xucheng Hou & Yizhou Dong

Article
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Temporal Contrastive Learning through implicit non-equilibrium memory

Artificial neural networks can be trained using backpropagation because of the sophisticated digital hardware they run on. Here, the authors show how many simple physical systems can autonomously be trained to perform complex computations without needing to interface with any digital hardware.

Martin J. Falk, Adam T. Strupp & Arvind Murugan

Article
04 March 2025 | Open Access

Mechanistic insights into nonlinear effects in copper-catalyzed asymmetric esterification

Nonlinear effects (NLEs) serve as a widespread tool in the study of asymmetric catalytic reactions; however, due to the diversity in ligand-metal coordination modes, the information obtained solely from the linear relationship between the ee values of ligands and products in complex systems is often indirect. Here, the authors report a method that directly connects the relationship between the ee values of metal complexes and products, with the purpose of determining the active species that occur in complex systems.

Xiaotao Zhu, Meirong Huang & Xinhao Zhang

Article
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A metamaterial scaffold beyond modulus limits: enhanced osteogenesis and angiogenesis of critical bone defects

Metallic bone scaffolds can't be soft and strong. Here, the authors design a two-stage metamaterial scaffold with decoupled strength and modulus. By inducing greater tissue strain, it enhances osteogenesis and angiogenesis in ulnar defects model.

Yu Qin, Zehao Jing & Yufeng Zheng

Article
04 March 2025 | Open Access

In-situ positive electrode-electrolyte interphase construction enables stable Ah-level Zn-MnO$_2$ batteries

Mn dissolution and unwanted byproducts result in capacity fading of MnO$_2$-based aqueous zinc batteries. Here, authors report an in situ-formed interphase on commercial MnO$_2$ that inhibits dissolution and generation of byproducts, resulting in improved battery performance.

Guojun Lai, Zequan Zhao & Jiang Zhou

Article
04 March 2025 | Open Access

Canted antiferromagnetism in a spin-orbit coupled S_{eff} = 3/2 triangular-lattice magnet DyAuGe

There have been numerous studies of rare-earth magnetic systems with magnetic frustration, for instance, on triangular lattices, however, these have primarily been limited to the case of an effective spin, S_{eff} = 1/2. Here, Kurumaji et al demonstrate the emergence of canted antiferromagnetic state with S_{eff} = 3/2 in DyAuGe via a combination of experimental probes.

Takashi Kurumaji, Masaki Gen & Taka-hisa Arima

Article
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Electron correlation and relativistic effects in the excited states of radium monofluoride

Heavy-atom molecules can possess complicated electronic structures due to pronounced electron correlation and relativistic effects. Here, the authors describe electronic states of RaF in detail by combining accurate spectroscopy and theory approaches.

M. Athanasakis-Kaklamanakis, S. G. Wilkins & C. Zülch

Article
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The role of water molecules in the dissociation of an electron-molecule contact pair

The hydrated electron is an important species in radiation chemistry. Here, the authors kinetically trap metastable states of anion-water clusters and show how water molecules drive the separation of the excess electron from a parent molecule.

Connor J. Clarke, E. Michi Burrow & Jan R. R. Verlet

Article

03 March 2025 | Open Access

Interplay between multipolar order and multipole-induced superconductivity in PrTi$_2$Al$_{20}$

The rare-earth superconductor PrTr_2Al$_{20}$ (Tr = Ti, V) possesses quadrupolar and octupolar but no magnetic dipolar moments. Here, the authors suggest an intimate link between the quadrupolar order parameter and the superconducting pairing in this material.

Akito Sakai, Yosuke Matsumoto & Satoru Nakatsuji

Article

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Robust non-Abelian even-denominator fractional Chern insulator in twisted bilayer MoTe$_2$

Recent experiments suggest the possibility of realizing fractional Chern insulators in twisted transition metal dichalcogenides. Here, the authors present numerics revealing a robust non-Abelian zero magnetic-field state that may be realized in twisted bilayer MoTe2 in a specific parameter range.

Feng Chen, Wei-Wei Luo & D. N. Sheng

Article

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Chiral sulfide and achiral sulfonic acid cocatalyzed enantioselective electrophilic tandem selenylation semipinacol rearrangement of allenols

Rearrangement reactions serve as crucial steps in syntheses of biologically active products and also provide intellectual and conceptual curiosities within the broad field of organic chemistry. Here, the authors report an electrophilic selenylation/semipinacol rearrangement of allenols, catalysed by a chiral Lewis base.

Ren-Fei Cao, Ruirui Su & Zhi-Min Chen

Article

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Controlled macroscopic shape evolution of self-growing polymeric materials

Shape-changing polymers are attractive in a range of applications, but achieving non-homogeneous growth is challenging. Here, the authors report the development of a method for controlled, growth-induced shape transformations in synthetic materials on the macroscale.

Xinhong Xiong, Xiaozhuang Zhou & Jiaxi Cui

Article

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A full-stack memristor-based computation-in-memory system with software-hardware co-development

The practicality of memristor-based computation-in-memory (CIM) is limited by the specific hardware design and the manual parameters tuning process. Here, the authors develop a full-stack CIM system with both hardware and software design for improved flexibility and efficiency.

Ruihua Yu, Ze Wang & Huaqiang Wu

Article

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Asymmetrical estimator for training encapsulated deep photonic neural networks

Training photonic neural networks is often a challenging process due to the non-ideal device behaviours. Here, the authors introduce the asymmetrical training method as a lightweight and efficient alternative for promoting photonic acceleration in wider application scenarios.

Yizhi Wang, Minjia Chen & Qixiang Cheng

Perspective

01 March 2025 | Open Access

Next-generation water-saving strategies for greenhouses using a nexus approach with modern technologies

The food and water crisis demands innovative agricultural solutions. Here, the authors propose a next-generation greenhouse water-saving strategy by integrating advanced technologies, including atmospheric water harvesting, superabsorbent polymers, radiative cooling, and solar-driven desalination.

Hao Zou, Fan Wang & Ruzhu Wang

Article

01 March 2025 | Open Access

Superstoichiometric reversible and manipulable copper-ion intercalation in niobium selenide

Attempts to extend the range of reversible intercalation stoichiometries in selenides are promising but challenging. Here, authors report a reversible controlled superstoichiometric intercalation in NbSe$_2$ with up to two copper-ions per molecule by triggering anionic redox.

Yuanhe Sun, Rui Qi & Daming Zhu

Article

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Inverse melting and re-entrant transformations of the vortex lattice in amorphous Re_6Zr thin film

Melting usually occurs with increasing temperature, however, for a few rare systems, increasing temperature can lead to crystallization, a phenomenon known as inverse melting. Here, Duhan et al observe inverse melting of superconducting vortices in an amorphous Re_6Zr thin film.

Rishabh Duhan, Subhamita Sengupta & Pratap Raychaudhuri

Article
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Integrated device of luminescent solar concentrators and electrochromic supercapacitors for self-powered smart window and display

Traditional luminescent solar concentrators generally require separated energy storage modules limiting applications in smart windows. Here, authors propose an integration between luminescent solar concentrators and electrochromic supercapacitors capable of photovoltaic conversion, energy storage, and electrochromism.

Shichao Huang, Haotian Guo & Chunlei Wang

Article
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Visible-light-driven CO_2 photoreduction over atomically strained indium sites in ambient air

Achieving visible-light-driven CO_2 photoreduction in ambient air is significant yet challenging. Here, the authors introduce strain into layered In_2S_3 at atomic scale for promoted CO_2 activation and boosted photogenerated charge carrier separation in atmospheric CO_2 photoreduction.

Kai Wang, Yanjun Hu & Bin Liu

Article
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Two-photon absorption under few-photon irradiation for optical nanoprinting

The efficiency of two-photon absorption nanoprinting is limited by the trade-off to reach high resolutions. Here the authors use ultralow photon irradiance to increase printing efficiencies while simultaneously achieving 26 nm feature sizes.

Zi-Xin Liang, Yuan-Yuan Zhao & Xuan-Ming Duan

Article
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Strong charge-photon coupling in planar germanium enabled by granular aluminium superinductors

Recently, disordered or granular superconductors have gained attention for their applications in quantum devices. Here the authors report a reproducible method to fabricate high-impedance granular Al resonators, followed by integration with quantum dot devices, achieving record hole-photon coupling strength.

Marián Janík, Kevin Roux & Georgios Katsaros

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In situ valence-transited arsenic nanosheets for multi-modal therapy of colorectal cancer

Chemotherapy-dominated multi-modal therapeutic strategy has the potential for eradicating colorectal tumors. Here this group reports a therapeutic strategy using arsenic-derived nanosheets depleting H2S enriching in CRC microenvironment while eliciting the photothermal activity/cytotoxicity of ultrasmall CuS nanoparticles against CRC cells.

Hongyue Zheng, Ke Zhang & Fanzhu Li

Article
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General lightweight framework for vision foundation model supporting multi-task and multi-center medical image analysis

Identifying and segmenting medical images plays a crucial role in advancing precision cancer treatment. This study proposes a Vision Foundation Model General Lightweight (VFMGL) framework, which facilitates the decentralized construction of expert clinical models for various medical image tasks.

Senliang Lu, Yehang Chen & Bao Feng

Article
28 February 2025 | Open Access

Unraveling the molecular basis of substrate specificity and halogen activation in vanadium-dependent haloperoxidases

Vanadium-dependent haloperoxidases (VHPOs) are versatile enzymes that catalyze oxidation of halides followed by halogenation of electron-rich substrates, but the factors dictating substrate and halogen specificity were unknown. Here, the authors show that a single-point mutation in the cyanobacterial bromoperoxidase *Am*VHPO facilitates a selectivity switch to allow aryl chlorination and elucidate the structural basis for this switch.

P. Zeides, K. Bellmann-Sickert & T. Gulder

Article
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Observation of metal-organic interphase in Cu-based electrochemical CO_2-to-ethanol conversion

Interphases are crucial in electrochemical systems, but their role in CO_2 electroreduction remains underexplored. Here, the authors report their importance in improving electrocatalytic performance by systematically investigating 180 molecular modifiers using an automatic electrocatalysis platform.

Yan Shen, Nan Fang & Cheng Wang

Article
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Direct observation of ultrafast symmetry reduction during internal conversion of 2-thiouracil using Coulomb explosion imaging

Ultrafast breaking of the molecular symmetry is a key process in photochemistry. Here the authors show direct observation during internal conversion of a heterocyclic molecule using Coulomb explosion imaging supported by simulations.

Till Jahnke, Sebastian Mai & Markus Gühr

Article
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Realization of a one-dimensional topological insulator in ultrathin germanene nanoribbons

Although 2D topological insulators have been experimentally realized, their 1D counterparts remain difficult to investigate. Here, the authors report the observation of 0D topological states localized at the ends of the zigzag-terminated germanene nanoribbons with a width below ~2 nm, indicating the emergence of a 1D topological insulator.

Dennis J. Klaassen, Lumen Eek & Pantelis Bampoulis

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Observation of higher-order time-dislocation topological modes

The authors establish the concept of time-defect topological modes, which are induced by the interplay between temporal defects and Floquet topology. Intriguingly, the realized time-defect topological modes exhibit spatial localization at the temporal defect, despite homogeneous lattice couplings across it.

Jia-Hui Zhang, Feng Mei & Suotang Jia

Article
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Signatures of Floquet electronic steady states in graphene under continuous-wave mid-infrared irradiation

Previous investigations of Floquet states in solid state samples have been mostly based on ultrafast light excitations. Here, the authors report evidence of non-equilibrium steady states in graphene under continuous-wave mid-infrared irradiation, consistent with a long-lived Floquet phase physical picture.

Yijing Liu, Christopher Yang & Nikolai G. Kalugin

Article
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Transient colloidal crystals fueled by electrochemical reaction products

Conventional methods for directed colloidal assembly struggle with temporal control and tunability of assembly states. This study demonstrates transient colloidal crystals that autonomously form, disassemble, and reassemble in response to an electrochemical reaction network, achieving wide tunability of lifetimes using multimode electric potentials.

Medha Rath, Satyam Srivastava & Taylor Woehl

Article
28 February 2025 | Open Access

Scalable preparation of perovskite films with homogeneous structure via immobilizing strategy for high-performance solar modules

Yuan et al. report pyrrodiazole additives for simultaneous immobilizing of lead iodide and formamidinium iodide during slot-die coating perovskite films in air, ensuring consistent growth rate for upper and lower layers of the film, leading to certified efficiency of 20.3% for 10 cm × 10 cm solar modules.

Shihao Yuan, Daming Zheng & Shibin Li

Article
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Ultrahigh capacitive energy storage of $BiFeO_3$-based ceramics through multi-oriented nanodomain construction

The authors make multi-oriented nanodomain in BiFeO3-based ceramics via the strategic design of a dipolar region with high resilience to electric fields, achieving high energy storage density of 12.2 J cm−3 and energy storage efficiency of 90.1%.

Zhixin Zhou, Wangfeng Bai & Zhongbin Pan

Article
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NIR-triggering cobalt single-atom enzyme switches off-to-on for boosting the interactive dynamic effects of multimodal phototherapy

Non-invasive phototherapy is promising for cancer treatment, but hindered by the lack of multimodal phototherapy agents that have a desirable tissue penetration depth. Here, the authors report an near-infrared light- triggered photodynamic-photocatalytic-photothermal therapy agent based on an atomically dispersed cobalt single-atom enzyme anchored on hollow N-doped carbon sphere.

Hao Dai, Ali Han & Yuguang Wang

Article

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Organic photovoltaic mini-module providing more than 5000 V for energy autonomy of dielectric elastomer actuators

The authors present organic photovoltaic mini-modules comprising 5024 individual sub-cells on an area of 3.8 × 3.9 cm^2 with voltages up to more than 5000 V and efficiencies up to 19%, to power a suction cup based on dielectric elastomer actuators.

Ershuai Jiang, Armin Jamali & Uli Würfel

Article

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Highly oxidized products from the atmospheric reaction of hydroxyl radicals with isoprene

Experiments demonstrate the formation of a series of oxidized C_4- and C_5-products from the OH + isoprene reaction including highly oxygenated molecules (HOMs). These HOMs could be important for the generation of secondary organic aerosols.

Torsten Berndt, Erik H. Hoffmann & Hartmut Herrmann

Article

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Artificial photosynthesis directed toward organic synthesis

Emulating the concept of natural photosynthesis has long been a focus of chemists in an effort to harness solar light as an energy source using water as an electron donor and a source material. Here, the authors present an artificial photosynthetic system that can functionalize styrenes via C–H activation and water splitting.

Shogo Mori, Riku Hashimoto & Susumu Saito

Article

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Magnetically reshapable 3D multi-electrode arrays of liquid metals for electrophysiological analysis of brain organoids

Conventional platforms for electrophysiological recording of organoids have limited recording site density. Here, the authors present the magnetically reshapable 3D liquid metal-based electrode array for high-resolution analysis on neural activities of brain organoids.

Enji Kim, Eunseon Jeong & Jang-Ung Park

Article

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Interference-free nanogap pressure sensor array with high spatial resolution for wireless human-machine interfaces applications

The authors use a nanogap structure in capacitive pressure sensors to suppress fringe fields, the cause of interference. This enables interference-free operation while achieving high resolution and bending insensitivity for human-machine interface applications.

Jae-Soon Yang, Myung-Kun Chung & Jun-Bo Yoon

Article

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Capturing ultrafast molecular motions and lattice dynamics in spin crossover film using femtosecond diffraction methods

The spin crossover films provide an efficient control of material properties by light excitation. In this work, the authors reveal sequential photo-switching dynamics, from local molecular rearrangement to global lattice deformation.

Doriana Vinci, Karl Ridier & Yifeng Jiang

Article

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Synthesis of high quality two dimensional covalent organic frameworks through a self-sacrificing guest strategy

The quality of covalent organic frameworks is often compromised by structural damages induced during their activation procedure which influences their subsequent applications. Here, the authors describe a self-sacrificing guest strategy to synthesize high-quality two-dimensional COFs by incorporating salt guests within the pores of the COF structure.

Tianwei Xue, Li Peng & Hai-Long Jiang

Article

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Molecular HDD logic for encrypted massive data storage

Organic memory devices, with small dimension, fast speed and long retention are promising candidates for data archiving. Here, the authors present a molecular hard-disk logic scheme capable of executing in-situ encryption of data in pW/bit power-consumption range.

Bingjie Guo, Xinhui Chen & Gang Liu

Article

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Operando TEM study of a working copper catalyst during ethylene oxidation

Investigating catalysts under their working conditions is crucial for understanding structure-performance relationships. Here, the authors utilize *operando* transmission electron microscopy and density functional theory calculations to explore the structure-performance correlations of a copper catalyst in ethylene oxidation.

Wenqian Yu, Shengnan Yue & Xing Huang

Article

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Ephemeral superconductivity atop the false vacuum

The authors theoretically study superconductors that are terminated by a first-order phase transition to a correlated phase of different symmetry, referred to as the false vacuum. They propose that quenching across this transition leads to a nonequilibrium ephemeral superconductor, detectable with simple transport probes.

Gal Shavit, Stevan Nadj-Perge & Gil Refael

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Article
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An infrared-transparent textile with high drawing processed Nylon 6 nanofibers

Infrared (IR)-transparent textiles are promising for thermal management systems, but fabrication from traditional textile methods remains challenging. Here, the authors propose a drawing process for Nylon 6 with high IR-transmittance and temperature reduction.

Zipeng Chen, Qian Zhang & Bin Zhu

Article
27 February 2025 | Open Access

Electrochemically in situ formed rocksalt phase in titanium dioxide determines pseudocapacitive sodium-ion storage

Earth-abundant TiO_2 is a promising negative electrode material for low-cost sodium-ion batteries. Here, authors show that ordered rocksalt $NaTiO_2$ nanograins are in situ formed by electrochemically cycling with Na^+ ions in anatase TiO_2, which determines the pseudocapacitive high-rate capability.

Dafu Tang, Ruohan Yu & Qiulong Wei

Article
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A synergistic coordination-reduction interface for electrochemical reductive extraction of uranium with low impurities from seawater

Electrochemical extraction of uranium from seawater is a promising strategy for the sustainable impurities. Herein, Guo et al construct a synergistic coordination-reduction interface, achieving electrochemical extraction of black UO2 product from seawater.

Hongliang Guo, Enmin Hu & Wenkun Zhu

Article
27 February 2025 | Open Access

Advancing nonadiabatic molecular dynamics simulations in solids with E(3) equivariant deep neural hamiltonians

Accurate nonadiabatic molecular dynamics (NAMD) is crucial for studying excited-state dynamics in solids but is computationally expensive. Here, authors use machine learning to enhance the efficiency and accuracy of NAMD simulations in solids.

Changwei Zhang, Yang Zhong & Hongjun Xiang

Article
27 February 2025 | Open Access

Lattice-driven gating in a Cu-based zeolitic imidazolate framework for efficient high-temperature hydrogen isotope separation

Using lattice-driven gating, a copper-based zeolitic imidazolate framework (Cu-ZIF-gis) with ultra-narrow 2.4 Å channels demonstrates efficient hydrogen isotope separation at high temperatures (above 120 K). This innovation leverages temperature-induced aperture adjustments to achieve sustainable and energy-efficient isotope separation, which is suitable for integration with existing LNG cryogenic infrastructure.

Minji Jung, Jaewoo Park & Hyunchul Oh

Article
27 February 2025 | Open Access

Unravelling the structure-stability interplay of O3-type layered sodium cathode materials via precision spacing engineering

O3-type layered oxides are promising intercalative electrode materials for Na-ion batteries. Here, authors analyze the interlayer spacings of a family of oxides and propose an intrinsic structural parameter to serve as a measure of cycling stability.

Meng Li, Haoxiang Zhuo & Biwei Xiao

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Operando impedance spectroscopy with combined dynamic measurements and overvoltage analysis in lithium metal batteries

Conventional EIS requires simplification and equilibrium conditions, limiting dynamic process observation. Here, authors tackle this with operando EIS and overvoltage monitoring in a 3-electrode Li metal cell, providing insights into Li^+ diffusion, surface morphology changes, and dendritic growth.

Sara Drvarič Talian, Gregor Kapun & Miran Gaberšček

Article
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Space-time wave packets in multimode optical fibers with controlled dynamic motions and tunable group velocities

Su et al. demonstrate ultra-fast light pulses in multimode fiber with dynamically evolving spatial profiles and tunable group velocities ranging from subluminal to superluminal and negative values, achieved through correlated space-time wave packets.

Xinzhou Su, Kaiheng Zou & Alan E. Willner

Article
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Asymmetric rotations slow down diffusion under confinement

Translation and rotation are the two most fundamental forms of diffusion. Here, the authors provide evidence of the coupling between rotation and translation under confinement, and find that asymmetric rotations disrupt the order of molecular diffusion in zeolites, which can be applied to studies of selective separation.

Zhiqiang Liu, Xun Kan & Anmin Zheng

Article
27 February 2025 | Open Access

Mesoscale orchestration of collagen-based hierarchical mineralization

Mesoscale building blocks are instrumental in bridging multilevel hierarchical mineralization, but the mechanism orchestrating the homogeneous morphology of mesoscale mineralized motifs in collagen-based hard tissues remains unknown. Here, the authors reveal a robust correlation between the mesoscale mineralized spherules and the presence of phosvitin.

Minjuan Shen, Chunyan Zhang & Qianming Chen

Article
26 February 2025 | Open Access

Interpolating numerically exact many-body wave functions for accelerated molecular dynamics

The wave function contains all the information about the electrons in chemical systems. Here, authors interpolate this quantum variable through chemical interactions, allowing us to follow the electronic state as atoms move and react.

Yannic Rath & George H. Booth

Article
26 February 2025 | Open Access

Unveiling the neglected role of oxygen doping in nitrogen-doped carbon for enhanced capacitive deionization performance

Nitrogen-doped carbons (NCs) have shown significant potential for capacitive deionization applications, but the roles of different nitrogen configurations and the synergistic effect of oxygen doping remain unclear. Here, this study addresses these issues and reveals the crucial impact of trace oxygen doping in enhancing the desalination performance of NC electrodes.

Jiabao Li, Ruoxing Wang & Yusuke Yamauchi

Article
26 February 2025 | Open Access

Precise placement of thioester bonds into sequence-controlled polymers containing ABAC-type units

The precise placement of thioester bonds into sequence-controlled polymers remains challenging. Here, the authors demonstrate the versatile synthesis of sequence-controlled polymers from the step polymerization of cyclic thioanhydrides, diacrylates, and diols/diamines.

Yanni Xia, Tong Shao & Xinghong Zhang

Article
26 February 2025 | Open Access

Magneto-ionic vortices: voltage-reconfigurable swirling-spin analog-memory nanomagnets

Magneto-ionics are a promising approach for controlling magnetism via electric fields, but most studies have been limited to thin films, rather than the nanostructures that would form the basis of a magneto-ionic memory unit. Here, Spasojevic et al demonstrate magneto-ionic control over transitions among paramagnetic, single domain, and vortex states in an array of nanodots.

Irena Spasojevic, Zheng Ma & Jordi Sort

Article
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Measurement of interfacial thermal resistance in high-energy-density matter

Heat transport across interfaces can be restricted due to interfacial thermal resistance between different materials. Here, authors find experimental evidence of a significant and enduring heat barrier between two high-energy-density materials that is consistent with interfacial thermal resistance.

Cameron H. Allen, Matthew Oliver & Thomas G. White

Article
26 February 2025 | Open Access

Self-growing protocell models in aqueous two-phase system induced by internal DNA replication reaction

Self-growth of cells has been a goal for replication in synthetic cells. Here, the authors report on the integration of a DNA amplification/replication system with the principle of DNA induced generation of dextran droplets to create self-growing artificial cell.

Yoshihiro Minagawa, Moe Yabuta & Hiroyuki Noji

Article
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Size control and oscillations of active droplets in synthetic cells

Oscillations in the formation and dissolution of molecular assemblies inside living cells are essential for various cellular functions and processes, but difficult to design in synthetic cells. Here, the authors show spontaneous emergence of spatio-temporal oscillations in the number of droplets, size, and their spatial distribution within a synthetic cell.

Judit Sastre, Advait Thatte & Job Boekhoven

Article
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A reconfigurable non-linear active metasurface for coherent wave down-conversion

A hybrid electronic-photonic reconfigurable metasurface radiates a scannable millimeter-wave beam under modulated optical wave illumination, demonstrating its application in a fiber-to-wireless communication link.

Pouria Sanjari & Firooz Aflatouni

Article
26 February 2025 | Open Access

Direct conversion of various phosphate sources to a versatile P-X reagent [TBA][PO_2X_2] via redox-neutral halogenation

The limited solubility, inherent chemical stability, and low reactivity of inorganic phosphates pose hinder their conversion into organophosphates under mild conditions. Here, the authors report a method for the direct conversion of phosphates into P(V)-X reagents via a redox-neutral halogenation process, using cyanuric chloride or cyanuric fluoride as the halogenation reagent.

Yaling Tian, Dong-ping Chen & Zheng-Jun Quan

Article
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Observation of dispersive acoustic quasicrystals

Moiré quasicrystals exhibit many exotic phenomena. Here, the authors report an acoustic moiré quasicrystal that not only achieves a localization-delocalization transition, but also enables wave propagation shifting from diffusion to canalization or localization.

Chenglin Han, Li-Qun Chen & Cheng-Wei Qiu

Article
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Enhanced energy storage performance of nano-submicron structural dielectric films by suppressed ferroelectric phase aggregation

The authors prepare an all-organic dielectric film with a nano-submicron surface layer via electrospinning technology, achieving a simultaneous improvement in the discharged energy density and charge/discharge efficiency.

Kun Xing, Yanan Hao & Zhi-Min Dang

Article
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Structure, motion, and multiscale search of traveling networks

Complex networks are relevant to wide range of areas, from biology to social sciences and economics, however the aspect that networks can move through space has not been elaborated. The authors propose a concept of traveling networks that can dynamically restructure themselves in space and perform search tasks.

Nate J. Cira, Morgan L. Paull & Ingmar H. Riedel-Kruse

Article
25 February 2025 | Open Access

Ultrafast structural dynamics of carbon–carbon single-bond rotation in transient radical species at non-equilibrium

Carbon–carbon single-bond rotation is a fundamental process in organic molecules. Here the authors use time-resolved X-ray liquidography to follow this motion in a haloalkane and its photodissociation product on an ultrafast timescale with atomic resolution.

Seonggon Lee, Hosung Ki & Hyotcherl Ihee

Article
25 February 2025 | Open Access

Fatigue-resistant and super-tough thermocells

Wearable thermocells are limited by poor durability and thermal inefficiencies. Here, the authors develop a high-strength, fatigue-resistant thermocell with enhanced thermoelectric performance. By enhancing crystal domains and entropy difference, it boosts fatigue resistance and thermopower.

Lili Liu, Ding Zhang & Rujun Ma

Article
25 February 2025 | Open Access

Electrically-driven reversible phonon transport manipulation in two-dimensional heterostructures

Phonon transport manipulation is highly desirable in various nano-technological applications. Here, the authors achieve flexible and reversible phonon transport manipulation in a two-dimensional heterojunction via electron-phonon interactions.

Yufei Sheng, Hongxin Zhu & Hua Bao

Article
25 February 2025 | Open Access

Broad-spectrum capture of hundreds of per- and polyfluoroalkyl substances from fluorochemical wastewater

Currently, a serious public health crisis caused by PFAS is of great concern worldwide. Here, the authors propose a treatment-train strategy that combines Zn-based EC with the existing AC/AER devices to enable the broad-spectrum removal of hundreds of PFAS from fluorochemical production effluents.

Yiyang Liang, Lihui Yang & Hui Lin

Article
25 February 2025 | Open Access

A stereodynamic probe of Pt(II) molecular hinge for chiroptical sensing of cryptochiral compounds

Cryptochiral compounds are indispensable in biology systems and medical applications, yet the development of high-performance detection method remains challenging. Here, the authors report hinge-like dinuclear Pt(II) complexes as stereodynamic probes for cryptochirality sensing.

Yeye Ai, Yinghao Zhang & Yongguang Li

Article
25 February 2025 | Open Access

Correlated states controlled by a tunable van Hove singularity in moiré WSe_2 bilayers

Twisted transition metal dichalcogenide bilayers exhibit several emerging physical properties, but the connection to the underlying band structure singularities remains difficult to determine experimentally. Here, the authors characterize the influence of an electrically tunable van Hove singularity in twisted bilayer WSe_2 on its ferromagnetic and topological phases.

Patrick Knüppel, Jiacheng Zhu & Kin Fai Mak

Article
25 February 2025 | Open Access

Harnessing organic electrolyte for non-corrosive and wide-temperature Na-Cl_2 battery

Rechargeable sodium-chlorine (Na-Cl_2) batteries hold promise for grid energy storage but face challenges of corrosive thionyl chloride ($SOCl_2$) electrolytes. Here, authors introduce a non-corrosive ester as an alternative, enabling Na-Cl_2 batteries with a wide temperature range from −40 to 80 °C.

Qiuchen Xu, Shanshan Tang & Hao Sun

Article
25 February 2025 | Open Access

Highly efficient and eco-friendly green quantum dot light-emitting diodes through interfacial potential grading

Bi et al. report eco-friendly green LEDs based on interfacial potential-graded ZnSeTe quantum dots with alleviated lattice mismatch and Auger recombination, resulting in peak efficiency of 21.7% at 520 nm, current efficiency of 75.7 cd A^{-1}, and half-lifetime of 99.4 h at 1000 nits.

Yuhe Bi, Jianhui Sun & Jialong Zhao

Article
25 February 2025 | Open Access

Local halide heterogeneity drives surface wrinkling in mixed-halide wide-bandgap perovskites

Surface wrinkling reduces the performance of mixed-halide perovskite solar cells. Here, the authors identify that sequential nucleation of bromide-rich and iodide-rich domains results in compositional heterogeneity and subsequent wrinkling.

Kunal Datta, Simone C. W. van Laar & René A. J. Janssen

Article
25 February 2025 | Open Access

Detection of ferrihydrite in Martian red dust records ancient cold and wet conditions on Mars

Mars' distinctive red colour attributed to ferrihydrite, a type of rust mineral. This finding suggests Mars experienced a cold and wet environment before transitioning to its current desert state.

Adomas Valantinas, John F. Mustard & Nicolas Thomas

Article
25 February 2025 | Open Access

Electronic metal-support interaction modulates Cu electronic structures for CO_2 electroreduction to desired products

Rational regulation of electronic structures to control CO_2 electroreduction pathways is challenging. Here, the authors report modulating the highest occupied orbital of Cu single-sites via electronic metal-support interaction, enabling switchable selectivity between multicarbons and methane.

Yong Zhang, Feifei Chen & Yahui Cheng

Article

24 February 2025 | Open Access

Additively-manufactured monocrystalline YBCO superconductor

Additive manufacturing can fabricate $YBa_2Cu_3O_{7-x}$ superconductors with complex shapes, albeit with a polycrystalline microstructure. Here, authors show a route combining the seemingly incompatible steps of 3D-ink extrusion printing and sintering, and single crystal growth.

Dingchang Zhang, Cristian Boffo & David C. Dunand

Article

24 February 2025 | Open Access

Controlling crystallization in covalent organic frameworks to facilitate photocatalytic hydrogen production

The authors report the transformation of an amorphous covalent organic framework to a crystalline state. This results in achieving optimum surface properties and enhances the photocatalytic production of hydrogen gas.

Zheng Lin, Xiangkun Yu & Jia Guo

Article

24 February 2025 | Open Access

Optimizing selectivity via steering dominant reaction mechanisms in steam reforming of methanol for hydrogen production

Improving selectivity for specific products remains a key challenge in energy catalysis. Here, the authors introduce a strategy for refining selectivity through pathway optimization, exemplified by the rational design of catalysts for methanol steam reforming.

Mengyuan Zhang, Zhi Liu & Hong He

Article

24 February 2025 | Open Access

Activating inert non-defect sites in Bi catalysts using tensile strain engineering for highly active CO_2 electroreduction

A large range of inert and non-defective sites in catalysts is a primary factor impeding catalyst activity in acidic CO_2 electroreduction. Here, the authors achieve high HCOOH selectivity and activity in acidic electrolyte by introducing tensile strain to activate inert sites.

Xingbao Chen, Ruihu Lu & Liqiang Mai

Article

24 February 2025 | Open Access

Deviatoric stress-induced transition of self-trapped exciton emissions

Deviatoric stress induces an intrinsic self-trapped exciton state (STE-2) and enables transitions between two intrinsic STE states in pyramidal ZnO nanocrystals. This approach results in a remarkable shift in emission energy, from 2.34 eV to 2.88 eV.

Chaofan Lv, Xigui Yang & Chongxin Shan

Article

24 February 2025 | Open Access

Deciphering a volcano-shaped relationship between radical stability and reticular electrochemiluminescence

Deciphering the relationship between radical stability and electrochemiluminescence performance is important since the stability of electrochemically generated radicals has an impact on the efficiency and durability of excited state generation. Here, the authors describe a volcano shaped relationship via modulating the electron affinity of three acrylonitrile-linked covalent organic frameworks.

Haocheng Xu, Rengan Luo & Kai Xi

Article

24 February 2025 | Open Access

Local chemical inhomogeneity enables superior strength-ductility-superelasticity synergy in additively manufactured NiTi shape memory alloys

Using laser powder bed fusion and a tailored heat treatment, the authors produce NiTi shape memory alloys with improved strength, ductility, and superelasticity enabled by high-density of Ni-rich local chemical inhomogeneity entities.

Zhonghan Li, Jixiang Cai & Shijie Hao

Article

24 February 2025 | Open Access

Superior electron transport in the single-crystalline TiCoSb-based half-Heuslers

The authors obtain the TiCoSb-based single-crystals with a dimension exceeding 1 cm, leading to an extraordinary enhancement in electron mobility and consequently, an average power factor of 37 W cm^{-1} K^{-2} in the Nb-doped TiCoSb single-crystal.

Sheng Ye, Shizhen Zhi & Jun Mao

Article

24 February 2025 | Open Access

Atomic mechanism of lithium dendrite penetration in solid electrolytes

The underlying mechanism of lithium dendrite penetration through ceramic electrolytes is debated. Here, authors employ MD simulations to enable atomic-scale investigation in the process of dendrite penetration and the concurrent development of cracks during solid state lithium battery operation.

Bowen Zhang, Botao Yuan & Yuanpeng Liu

Article

24 February 2025 | Open Access

Drop-shaped microgrooves guide unidirectional cell migration for enhanced endothelialization

Endothelialization of the left atrial appendage (LAA) occluder is vital in addressing device-related thrombosis. Here, the authors report LAA occluders integrated with drop-shaped microgrooves to guide unidirectional cell migration for enhanced endothelialization.

Xing-wang Wang, Cheng-qiang Ye & Jian Ji

Article

24 February 2025 | Open Access

Endosomal trafficking participates in lipid droplet catabolism to maintain lipid homeostasis

Lipid droplets (LDs) and endosomes play crucial roles in cellular processes, yet their interplay is poorly understood. Here, the authors develop an LD-specific probe, AP1-coumarin, and reveal dynamic interactions between LDs and endosomes, regulating lipid homeostasis.

Wang Peng, Shu Chen & Jianbo Yue

Article

24 February 2025 | Open Access

Identification of splenic IRF7 as a nanotherapy target for tele-conditioning myocardial reperfusion injury

Treating myocardial reperfusion injury via nanotherapy is challenging due to clearance by the mononuclear phagocyte system. Here, the authors target the spleen to reduce acute heart injury and improve long-term cardiac function via transient IRF7 inhibition.

Qiang Long, Kristina Rabi & Xiaofeng Ye

Article

24 February 2025 | Open Access

Ultra-low extracorporeal volume microfluidic leukapheresis is safe and effective in a rat model

Leukapheresis is prohibitive in newborns due to the large extracorporeal volume. Here, the authors develop a microfluidic device to perform leukapheresis on whole blood at clinically relevant flow rates and show its safety and efficacy in animals.

Mubasher Iqbal, Alexandra L. McLennan & Fong W. Lam

Article

23 February 2025 | Open Access

Electrochemical epoxidation enhanced by C_2H_4 activation and hydroxyl generation at the Ag/SnO_2 interface

Electrochemical epoxidation by water is mainly hindered by the sluggish activation of C_2H_4 and the stiff formation of *OH intermediate. Here, the authors report an Ag/SnO_2 interface to promote C_2H_4 adsorption and electrophilic *OH generation, leading to promoted production of ethylene oxide.

Hao Dong, Ran Luo & Jinlong Gong

Article

23 February 2025 | Open Access

Preclinical tumor control with a laser-accelerated high-energy electron radiotherapy prototype

Radiotherapy using very-high-energy electron (VHEE) beam is promising for tumor treatment. Here this group reports a compact and one-month stable VHEE system with high energy laser wakefield acceleration technique enabling the effective tumor irradiation comparable to commercial X-ray radiotherapy.

Zhiyuan Guo, Shuang Liu & Wei Lu

Article

23 February 2025 | Open Access

Coupling of electronic transition to ferroelectric order in a 2D semiconductor

Experimental evidence for charge coupling to ferroelectric soft mode is scarce. Here, the authors find a photogenerated coherent phonon coupling to the electronic transition above the bandgap in the van der Waals ferroelectric semiconductor NbOI2.

Chun-Ying Huang, Daniel G. Chica & Xiaoyang Zhu

Article

23 February 2025 | Open Access

A tunable entangled photon-pair source based on a Van der Waals insulator

Compact sources of entangled photons are desired for quantum communication, computing, and cryptography. Here, the authors report high entangled photon pair generation rates in rhombohedral boron nitride, showing its potential as a tunable platform for Bell state generation.

Xiaodan Lyu, Leevi Kallioniemi & Weibo Gao

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