

Physical sciences articles within *Nature Communications*

Featured

Article

Interfacial water regulation on Ru single atoms doped Co₃O₄ toward efficient electrochemical hydrogenation of quinoxaline

Electrochemical hydrogenation of quinoxaline is a promising alternative to traditional methods but is limited by low current density and faradaic efficiency. Here, the authors report a Ru single atoms doped Co₃O₄ monolayer that regulates interfacial water to achieve excellent performance.

Linghu Meng, Tianyi Dai & Yongwen Tan

Article

Iterative discovery of potent polymeric antibiotics via multi-stage and multi-task learning against antimicrobial resistance

In this work, Wu et al. develop and present PolyCLOVER, a framework that integrates multi-stage learning, active learning, and high-throughput experimentation to iteratively discover potent, low-toxicity polymeric antibiotics without relying on external labelled data.

Yuhui Wu, Cong Wang & Peng Zhang

Article

Intrinsically stretchable 2D MoS₂ transistors

Intrinsically stretchable electronic devices are interesting for wearable electronics, soft robotics, and stretchable display applications. Here, the authors report the fabrication of intrinsically stretchable solution-processed thin-film transistors based on 2D MoS₂ flakes, showing high performance and stability under strain up to 20%.

Kyunghun Kim, Yasutaka Kuzumoto & Tae-Gun Kim

Article

20 January 2026 | Open Access

On the fundamental resource for exponential advantage in quantum channel learning

While it is known that entanglement plays a role in learning the properties of unknown physical systems, the detailed quantitative dependence is unclear. Here, the authors investigate the fundamental resources behind quantum advantage in channel learning, revealing that while extensive entanglement is unnecessary, the number of ancilla qubits is crucial.

Moses Kim & Chang-hu Oh

Article

20 January 2026 | Open Access

Near-100% site utilization of single atoms for efficient electrocatalysis

Enhancing utilization of single atoms is crucial but challenging in electrocatalysis. Here, the authors present a surfactant-assisted freeze-casting method to optimize nanocarbon micro- and macrostructures, achieving near 100% site utilization and enhancing single-atom catalytic performance.

Xiaocang Wei, Meng An & Yusaku Nansaku

Article

20 January 2026 | Open Access

Non-traditional fluorescence in quadruple hydrogen bonded supramolecular polymers

Non-traditional fluorescent supramolecular polymers without extended π -conjugation. Here the authors develop highly luminescent supramolecular polymers using dynamic quadruple hydrogenbonded motifs with potential for sensing and fluorescent adhesives.

Hao Zuo, Yi Zhang & Xinbin Wang

Article

20 January 2026 | Open Access

Operando nuclear magnetic resonance decodes alkali-tuned proton-electron relay boosting CO₂-to-formate conversion

Understanding how alkali doping promotes CO₂ electroreduction is challenging as tracking proton transfer is difficult. Here, the authors report operando nuclear magnetic resonance spectroscopy reveals Li doping provides a proton-electron relay from water, thereby boosting CO₂-to-formate conversion.

Yingli Shi, Ying Liu & Ye-Feng Yao

Article

20 January 2026 | Open Access

Precision bounds for characterising quantum measurements

In this work, the authors propose and experimentally test a framework to analyze the fundamental limits of quantum detector tomography, i.e. the limits to extractable information from probing unknown quantum measurements. They introduce the detector quantum Fisher information, which physically corrects measurement structure to quantum advantage, complementing previously known state and channel metrics.

Anirba Das, Simon K. Yung & Jié Zhao

Article

20 January 2026 | Open Access

Chainmail-inspired conformable and switchable microwave metamaterial absorber

Authors present a chainmail-inspired microwave absorber fabricated via 3D printing, that adapts to complex surfaces with minimal performance degradation. It allows dynamic frequency tuning through structural reconfiguration, providing a combined absorption bandwidth from 4.6 to 18 GHz across different configurations.

Ruiyang Tan, Jintang Zhou & Ping Chen

Article

20 January 2026 | Open Access

High-spin state dynamics and quintet-mediated emission in intramolecular singlet fission

This study reveals high-spin state formation and quintet-mediated emission in diphenylbenzene oligomers. Quintet states dominate delayed fluorescence up to room temperature, establishing a spin-selective platform for quantum technologies.

Jeanneine Grims, Steph Montanaro & Neil C. Greenham

Article

20 January 2026 | Open Access

Nickel-catalyzed divergent sulfonations of propargylic carbonate

Chiral sodium sulfonates serve as crucial synthetic intermediates utilized for rapidly producing a variety of enantioenriched chiral derivatives that are pervasive in the fields of pharmaceutical chemistry and chemical synthesis. Here, the authors report the nickel-catalyzed asymmetric sulfonation of propargylic carbonates, synthesizing chiral sulfonates, propargylates, allenylates, and 1,3-dienylates sulfones with high enantioselectivity.

Wenjing Gu, Zhuoshu He & Chang Guo

Article

20 January 2026 | Open Access

Low temperature and rapid photothermal oxidation of liquid gallium for circular hydrogen production

Photothermal reactions between liquid gallium and water or seawater enable hydrogen production under light exposure. The authors show that the metal can be regenerated electrochemically, supporting a reusable and sustainable cycle for hydrogen.

Luiz G. B. Campos, Francisco-Marie Alloua & Kouroush Kalantar-Zadeh

Article

20 January 2026 | Open Access

Wafer-scale high- κ HfO₂ dielectric films with sub-5 Å equivalent oxide thickness for 2D MoS₂ transistors

The integration of high- κ dielectrics with low equivalent oxide thickness (EOT) is crucial for the development of 2D transistors. Here, the authors report the low-temperature fabrication of wafer-scale HfO₂ dielectric films with sub-5 Å EOT and their application for the realization of high-performance 2D MoS₂ transistors and circuits.

Songze Zhang, Tao Zhang & Guangyu Zhang

Article

20 January 2026 | Open Access

Ligand-controlled regioselective and enantioselective C–H cyanation of secondary amines

The controllable regio- and enantioselective C–H bond transformation of secondary amines at different β -alkyl groups has remained underdeveloped. Here, the authors report a Cu-catalyzed α/β -regioselective and β -enantioselective cyanation of secondary amine-derived ureas through ligand-controlled adjustable 1,4,1,5-hydrogen atom transfer.

Yang-Jie Mao, Xuhai Chen & Dan-Qian Xu

Article

20 January 2026 | Open Access

Bionic Janus hydrogel drives infected Achilles tendon regeneration via mechano-immune spatiotemporal steering

Healing of infected tendons is hindered by mechanical dysfunction, tissue adhesion, and immune imbalance. Here, Li et al. develop a multifunctional Janus hydrogel with asymmetric adhesion, antibacterial properties, and pro-regenerative release of tendon stem cell-derived exosomes for infected tendon repair.

Je Li, Zishuo Wang & Shuo Fang

Article

20 January 2026 | Open Access

Upcycling carbon fibre wastes in solid flames

To overcome inefficient recycling of carbon fibre waste, the authors develop a rapid, commercially attractive solid flame upcycling technique that converts waste fibres into graphene-grafted carbon fibres and graphene powder.

Qingtan Ren, Jie Sheng & Weidong Fei

Article

20 January 2026 | Open Access

Distributed multi-parameter quantum metrology with a superconducting quantum network

Distributed multiparameter quantum metrology allows to probe multiple spatially distributed parameters across networked quantum systems. Here, the authors demonstrate distributed multiparameter quantum metrology in a modular superconducting quantum processor network.

Jiajun Zhang, Lingna Wang & Diqiang Yu

Article

20 January 2026 | Open Access

De-coherent parallel laser processing of ultradense nanopores for high-density, large-area 3D optical phase encoding

The authors present a de-coherent parallel direct laser writing (DC-PDLW) strategy that combines a patterned single pulse with a de-coherent hologram algorithm to achieve 30 nm (x)-15 nm (y) resolution in crystal, enabling centimeter-scale 3D phase plates and dense 3D phase coding.

Zhenli Jiang, Jiancheng Hu & Jianrong Qiu

Article

20 January 2026 | Open Access

Morphology-modified contributions of electronic transitions to the optical response of plasmonic nanoporous gold metamaterial

Nanoporous metals offer the potential for tunability of electronic and optical properties. Here, the authors combine experimental studies and theoretical modeling to explore how nanoporous morphology shapes the intraband and interband contributions to the optical response of gold.

Tak Tepani, Jona M. Pettersson & Niccolò Maccarani

Article

20 January 2026 | Open Access

Glycine biosynthesis via C–N coupling of waste plastic and nitrate over photoactive Pt–In catalyst

This work describes a Pt–In bimetallic catalyst that can selectively catalyze the photoreduction of glycine via C–N coupling reaction between Pt–In-derived ethylene glycol and nitrate, achieving a yield of 2.9 mmol g_{cat}^{−1} h^{−1} and selectivity of 92%.

Zongqiang Ye, Mile Li & Jintong Dong

Article

20 January 2026 | Open Access

Endothelin-3 and L-type Ca²⁺ channels drive enteric neural crest self-calcium activity, contractility and migration

Neural crest cells migrate in the embryo to form the gut's nervous system. Researchers found that endothelin-3 triggers electrical oscillations via L-type calcium channels, enabling these cells to contract like 'mini muscles' and colonize organs.

Nicolas K. Chevillon, Henry Geyda & Léna Zieg

Article

20 January 2026 | Open Access

Human motion recognition and prediction using loose cloth

Conventional methods for human motion analysis using sensors tightly attached to the body are often uncomfortable. Here, the authors demonstrate motion recognition and prediction using sensors embedded in garments. The results provide guidance for the development of wearable technology integrated into everyday clothing.

Tianchen Shen, Sacha Morris & Matthew Howard

Article

20 January 2026 | Open Access

High-entropy alloy Janus artificial enzymes for pH-gated sequential redox therapy of drug-resistant bacterial infection

Chronic non-healing wounds infected with antibiotic-resistant bacteria present a growing global health challenge. Here, Han et al. develop high-entropy alloy-based Janus artificial enzymes with pH-gated redox biocatalysis for sequential therapy of drug-resistant bacteria and inflammatory wounds.

Cong Han, Yongqi Wang & Chong Cheng

Article

20 January 2026 | Open Access

Low resistance p-type contacts to monolayer WS₂ through chlorinated solvent doping

2D p-type transistors are essential for the realization of complementary circuits for post-silicon electronics. Here, the authors report a chloroform doping strategy to fabricate p-type monolayer WS₂ transistors with high performance and long-term stability.

Lauren Hoang, Robert K. A. Bennett & Andrew J. Mannix

Article

20 January 2026 | Open Access

Expanding the payload scope in antibody-drug conjugates by delivery of hydroxy-containing drugs through self-immolative phosphoramidates

Approved antibody-drug conjugates (ADCs) remain constrained by a limited repertoire of payloads with restricted modes of action. Here, the authors present phosphoramidate-based self-immolative linker units that facilitate stable attachment in serum and traceless drug release in the target cell from aliphatic and aromatic alcohols with various modes of action.

Philipp Oettiger, Axel P. Jaspert & Marc-Alexis Kasper

Article

20 January 2026 | Open Access

A dressed singlet-triplet qubit in germanium

Hole spin qubits in germanium have seen significant advancements, though improving control and noise resilience remains a key challenge. Here, the authors realize a dressed singlet-triplet qubit in germanium, achieving frequency-modulated high-fidelity control and a twofold increase in coherence time.

K. Tsoulalas, Li van Ligt & P. Hanley-Collard

Article

20 January 2026 | Open Access

A detachable crawling robotic hand

This study introduces a detachable robotic hand that can detach from a manipulator, crawl to retrieve several objects, and reattach. A symmetric, reversible design enables grasping from both sides, bridging manipulation with autonomous mobility.

Xiao-Guo, Kungang Yao & Aude Billard

Article

20 January 2026 | Open Access

Predictive design of stretchable electrodes with strain-insensitive performance via robotics- and machine learning: integrated workflow

Stretchable electrodes are essential for wearable electronics and soft robots, yet their performance always degrades under strain. Here, authors use robotics- and machine learning integrated workflow to design microstructured nanocomposites for strain-insensitive gold conductors and zinc batteries.

Haochen Yang, Gongyu Chen & Po-Yen Chen

Article

19 January 2026 | Open Access

Electric-field-driven CO₂ polarization and bioinspired proton blocking unlock CO₂ reduction in strong acid without metal cations

Metal-cation-free CO₂ electroreduction in strong acid minimizes reactant loss and salt precipitation yet struggles with CO₂ activation and hydrogen evolution competition. Here, the authors report bioinspired sharp gold triangles with a proton-blocking layer that polarize CO₂ and suppress hydrogen evolution.

Liwei Chen, Zhenbin Guo & Jian Song

Article

19 January 2026 | Open Access

Interfacial evaporation-induced localized multi-field coupling enables efficient co-recovery of freshwater and nitrates

Recovering nitrate from surface water can help address interconnected environmental, resource, and energy challenges. A bioinspired photothermal evaporation platform enabling the co-recovery of low-concentration nitrate and freshwater is proposed.

Zhen Yu, Lei Shi & Seung Chan Tan

Article

19 January 2026 | Open Access

3D Printing of glasses with tunable UV–VIS–IR photoluminescence via low-temperature nanoscale engineering

Here authors report 3D printed glass with tunable UV-to-IR emission. The method overcomes thermal limits, integrating various quantum dots into 3D printed complex glass structures to enable advanced photonic functionalities.

Fenglian Zhou, Yingguo Yang & Juan Du

Article

19 January 2026 | Open Access

Controlled hierarchical self-assembly of hyperbolic paraboloid molecules into two-dimensional superstructures with second-harmonic generation characteristic

Hyperbolic paraboloid molecules possess unique physicochemical properties. However, their controlled organization into well-defined superstructures remains challenging. Here, the authors report a macrocycle with hyperbolic paraboloid topology as building blocks to self-assemble a series of two-dimensional superstructures with four-level hierarchy in a controlled hierarchical manner.

Hongbin Huo, Yuesong Zhang & Wei Tian

Article

19 January 2026 | Open Access

Enhanced proton conductivity in azole-functionalized three-dimensional crystalline covalent organic frameworks

Polycrystalline disorder often obscures the proton conduction pathways and mechanisms in covalent organic frameworks. Here, the authors functionalize 3D crystalline covalent organic frameworks under solvent-free conditions achieving ambipolar superprotonic conductivity and studied the mechanism behind.

Aoping Yao, Changyan Zhu & Donglin Jiang

Article

19 January 2026 | Open Access

Resolving energy transfer dynamics in Fe²⁺-activated multi-site phosphors via metaheuristic optimization and physics-informed neural networks

Multi-exponential fitting is commonly used for photoluminescence (PL) decay despite its limited physical meaning, largely replacing computationally demanding rate-equation models. The authors use AI-assisted simulations and a physics-informed end-to-end framework to fit PL decay data, obtaining results consistent across both approaches.

Byung Do Lee, Young Hoon Seo & Kise-Sun Sohn

Article

19 January 2026 | Open Access

Zinc-based metal halide electrolytes for all-solid-state zinc-metal batteries

Zinc-metal batteries are restricted by their inherent high activity of aqueous electrolyte. Here, authors report the design of a new class of zinc-based hybrid metal halide solid-state electrolytes, offering a promising avenue for all-solid-state zinc batteries.

Sanhui Hu, Caiyun Chang & Cuiying Han

Article

19 January 2026 | Open Access

In-memory analog computing for non-negative matrix factorization

The implementation of non-negative matrix factorization—a powerful technique finding hidden patterns in high-dimensional data—remains challenging due to computational complexity. Wang et al. report an in-memory analog solver, enabling accurate factorization with fast operation at low power consumption.

Shiqing Wang, Yubiao Luo & Zhong Sun

Article

19 January 2026 | Open Access

Physical neural networks using sharpness-aware training

Physical neural networks offer more efficient AI hardware, however their training remains challenging. Here, authors introduce Sharpness-Aware Training for physical neural networks to increase their robustness, generalizability, and resilience to real-world perturbations without retraining.

Tengji Xu, Zeyu Luo & Chaoren Huang

Article

19 January 2026 | Open Access

Differential membrane lipid disruption by lipopeptide antibiotics, colistin and turnericyclamycins

Lipopeptides are used to combat drug-resistant infections, but drawbacks limit their application. Here, Lin et al. contrast the mechanisms of lipopeptide that are superficially similar yet disrupt membranes in distinctly different ways.

Alibabson L. Lin, Bailey W. Miller & Eric W. Schmidt

Article

19 January 2026 | Open Access

Model-agnostic linear-memory online learning in spiking neural networks

Online learning of rich spiking dynamics remains a major challenge in scalable neuromorphic modeling. Here, the authors introduce BrainFlow, an automated, memory-efficient framework that enables general online learning up to whole-brain scale.

Chaoxing Wang, Xingyu Dong & Si Wu

Article

19 January 2026 | Open Access

Disruption of iron homeostasis sensitizes pancreatic cancer to irreversible electroporation

Irreversible electroporation (IRE) is a treatment for pancreatic cancer, but its efficacy is limited by uneven electric field distribution. Here, the authors show that combining iron-based nanoparticles and PEGTAC-mediated degradation of ferritin heavy chain-1 (FHC1) enhances IRE efficacy by inducing ferroptosis.

Lirong Li, Shihao Su & Jun Zhao

Article

19 January 2026 | Open Access

Wearable intelligent throat enables natural speech in stroke patients with dysarthria

Wearable silent speech systems hold promise for restoring communication in stroke patients suffering from speech impairments. Tang et al. report an AI-driven silent speech system for dysarthria patients, which enables zero time-delay expression and context-aware emotion decoding-based sentence expression.

Chenyu Tang, Shuo Gao & Liang G. Ouchipinti

Article

19 January 2026 | Open Access

Bioinspired flexible sensing-processing-visualizing integrated system towards tactile-visual signal recognition

The authors present a wearable bio-inspired sensing-processing-visualizing integrated system for tactile-visual recognition, multi-sensory interaction, trajectory recognition, and real-time feedback.

Zhen Wang, Jiaojiao Lin & Wei Huang

Article

19 January 2026 | Open Access

Multiple hydrogen bonding enables large-area doped phosphorescent glasses with robust stability and high-temperature afterglow

Materials with room temperature phosphorescence have a range of potential applications, but when crystalline can be brittle and optically non-transparent. Here, the authors report the development of supramolecular glasses by exaporation-induced assembly, with high-temperature afterglow properties.

Chuanli Chen, Yuechen Yang & Dongpeng Yan

Article

19 January 2026 | Open Access

Macrocycle-assembled membranes for high-salinity organic wastewater treatment

Macrocycle polymer membranes are well suited for wastewater treatment, though it is challenging to fabricate porous networks using macrocycles. Here the authors report a membrane containing tetraazacycle expanded calixarene using a unidirectional diffusion-assisted interfacial polymerization method for a wastewater treatment membrane.

Yuhou Li, Yanghua Duan & Menachem Elimelech

Article

19 January 2026 | Open Access

Distinct magneto-optical response of Frenkel and Wannier excitons in CrSBr

This study shows that CrSBr hosts Frenkel-like and Wannier-like-like excitons whose distinct spatial character explains their contrasting sensitivity to magnetic order and lattice vibrations, challenging the standard dichotomy in describing excitons.

Matth Semerita, Michal Kryzha & Paulina Pichocka

Article

19 January 2026 | Open Access

Spectroelectrochemical insight into copper cobalt catalysts for CO₂ and nitrite co-electroreduction to urea

Electrochemical conversion of CO₂ and nitrite offers a green route to produce urea. Here, the authors report on sophisticated copper cobalt catalysts enable efficient C–N coupling through a tandem mechanism, yielding 61 mmol h^{−1} g_{cat}^{−1} urea at −1.2 V vs. RHE.

Puhi Ramasubany, Wanli Tian-Pu & Fuhan Caoyan

Article

19 January 2026 | Open Access

Membrane-free CO₂ hydrogenation electrolyzer for salt precipitation management in acidic electrochemical CO₂ reduction

Acidic electrochemical CO₂ reduction promises efficient carbon use, but maintaining stable acidity at high current remains a major challenge. Here, the authors demonstrate a membrane-free CO₂ hydrogenation electrolyzer that stabilizes pH and enables efficient and stable formic acid production.

Yuxin Dai, Lili Fan & Wei Chen

Article

19 January 2026 | Open Access

Valence-free open nanoparticle superlattices

Tuning surface charge and polymer length enables PEG-grafted nanoparticles to assemble into cubic superlattices resembling ZnS, NaCl, CsCl, simple cubic and diamond, offering a programmable route to valence-free crystals.

Binay P. Nayak, Wedgie Wang & David Vabnick

Article

17 January 2026 | Open Access

Multi-layer oxide protection layer with multiple tunnelling paths for efficient and durable Si-based photocathode

A universal approach to control the resistance oxide layer by multiple tunnelling paths is proposed for efficient and durable Si-based photocathode. This approach can speed up the pace of development of practical photoelectrochemical devices.

Yong Zhou, Zifeng Cheng & Jianqun Zheng

Article

17 January 2026 | Open Access

Efficient solution-processed light-emitting diodes based on organic-inorganic hybrid antimony halides

Materials for organic cathode engineering strategy to improve the luminescent properties and charge transport in organic-inorganic antimony halides, enabling red LEDs with efficiency up to 14.8% and half-satellite of 10,160 nm. Large area (12.15 cm²) LEDs show efficiency of 14.2%.

Zhangshuang Ma, Weibing Chu & Zhifeng Shi

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Featured

Article

17 January 2016 | Open Access

Twist-stacked black phosphorus for wide-spectral chiral photodetection

On-chip circularly polarized light (CPL) detectors are relevant for various applications, but current approaches have shown a trade-off between wide spectral detection range, high discrimination ratio and high polarization sensitivity. Here, the authors report broadband high-performance CPL detectors based on twisted black phosphorus structures.

Hao Jiang, Lihang An & Weibo Gao

Article

17 January 2016 | Open Access

Exciton-polariton photodiodes

While excitonic semiconductors offer appealing optical properties, their application for competitive optoelectronic devices has remained limited. Here, the authors report the realization of broadband exciton-polariton photodiodes based on a layered excitonic semiconductor, WSe₂, contacted by In-doped indium oxide in an open optical cavity design, showing ~10-nm bandwidth at room temperature.

Qianqian Zhao, Adam G. Eiler & Weida Hu

Article

17 January 2016 | Open Access

Unconventional hysteretic due to time-reversal symmetry breaking superconductivity in RhV-Sb₂

The authors report the first reversal symmetry breaking superconductivity in the thin-RhSe Kagome material RhV₂Sb₂, manifesting primarily as an unconventional form of hysteresis that is not observed in CuV₂Sb₂. They also observe reentrance of superconductivity during an in-plane field-sweeping process at 400 mK.

Shuo Wang, Xilin Feng & Daqiang Yu

Article

17 January 2016 | Open Access

Gradient nanofiber aerogels for extreme cryogenic and thermal environments

Inspired by nature, this study reports a dual-gradient aerogel via freeze-casting. It blends flexibility with rigidity, offers high sensitivity and wide range, withstands extreme heat and cold, with promise for integration in spacecrafts.

Chunmei Li, Rui Xu & Peng Wang

Article

16 January 2016 | Open Access

Real-time visualization of sub-particle reaction anisotropy via rotary-encoded scattering microscopy

This study reports an optical imaging approach that encodes structural information into scattering patterns, enabling real-time visualization of sub-particle reaction dynamics in liquid environments.

Jun-Hao Xian, Gang Wu & Xian-Wei Liu

Article

16 January 2016 | Open Access

Quantum boomerang effect of light

Light launched into a disordered photonic chip first drifts, then unexpectedly reverses and returns to its point of origin. This work presents the first real-space observation of this quantum boomerang effect challenging, here, the authors demonstrate time-varying coupling can accelerate the return dynamics.

Xianghui Hou, Zhenbin Wu & Zhenqiang Yang

Article

16 January 2016 | Open Access

Reentrant melting of scarred odd crystals by self-defects

Geometrical frustration in confined systems can lead to the emergence of topological defects, which significantly influence the physical properties of materials. This study demonstrates that grain boundary spins in dense assemblies of three-spinners can dislocate edge flows from the bulk, resulting in spontaneous self-shearing and a chiral activity-mediated reentrant melting transition.

Utsumi Tawari, Pradyot Anand & Rajesh Ganapathy

Article

16 January 2016 | Open Access

Cascading chirality from molecule to twisted microstructures with amplified circularly polarized luminescence

Control of chiral assembly across length scales is desirable but challenging; here, the authors report the development of microspiral chiral twists prepared by the hierarchical assembly of enantiomeric amphiphiles.

Ying Pan, Tao Wang & Minghui Liu

Article

16 January 2016 | Open Access

Reticulating node-linker-modulator chemical spaces for modular design of alkoxide-based glasses and liquids

Here the authors show a general method to make alkoxide-based network-forming glasses with tunable properties by combining titanium, zirconium and boron-based nodes, multi-dentate alcohol linkers and mono-dentate alcohol modulators.

Ying Liu, Yueping Jiang & Yingqiao Zhao

Article

16 January 2016 | Open Access

Giant unusual anisotropic magnetoresistance enabled by hole-electron resonance in van der Waals heterostructures

High-electron resonance in WSe₂ unlocks Coulomb-unconstrained spin transfer across WSe₂/Fe₃GeTe₂, producing a giant 200% unusual anisotropic magnetoresistance and chiral transport transport beyond conventional spin-transport models.

Qian Chen, Yuan Tian & Ke Xia

Article

16 January 2016 | Open Access

Breaking the oxo-wall for Co(IV)-oxo species and their nanoconfined catalytic performance within Ce-Co lamellar membrane

Authors overcome the 'oxo-wall' effect of Co(IV) + O complexes, offering the lamellar Ce-Co tetra-(4-carboxyphenyl) porphyrin framework membrane for sustainable Co(IV) + O-mediated advanced oxidation processes in water treatment.

Mengjiao Tian, Hongqi Zhang & Zhenghua Zhang

Article

16 January 2016 | Open Access

Suppressing solvent adducts via coordination competition enables scalable perovskite photovoltaics

Scalable fabrication of perovskite films for large-area solar cells remains a critical challenge. In et al. identify the solvent-precursor interaction time as a crucial, yet overlooked, kinetic parameter controlling crystallization and propose a protocol for manufacturing high-quality perovskite films.

Lu Xu, Shaochun Zhang & Rui Wang

Article

16 January 2016 | Open Access

Spin-state engineering of single titanium adsorbates on ultrathin magnesium oxide

The study shows that the spin state of a single titanium atom on an insulating surface can be reversibly switched by its local environment, without chemical changes (no hydrogenation), using advanced microscopy, spectroscopy, and theory.

Soo-hyun Park, Hong-Tai Bu & Nicolás Lorente

Article

16 January 2016 | Open Access

Atomic-scale mechanism unlocks thermal-stable high- κ performance in HfO₂- ν a coherent interfaces

Developing hafnium dioxide-based high- κ dielectrics via morphotopic phase boundaries remains challenging. This study proposes a thermal-stable high- κ strategy via coherent interface design and elucidates the atomic-scale enhancement mechanism.

Yihao Shen, Hongsheng Wang & Huijun Zhang

Article

16 January 2016 | Open Access

Near-infrared light-driven nanomotors-based microneedles for the active therapy of bacterial infected acne

Acne is a common skin disease caused by the anaerobic *Cutibacterium* zones. Here, the authors report a microneedles patch loaded with near-infrared-driven self-organizing ZnO@Pd-MnO₂ nanomotors for photothermal therapy of acne.

Ziwei Hu, Yuyang Guo & Yingfeng Tu

Perspective

16 January 2016 | Open Access

Advances, challenges and prospects of origami and kirigami on electronics

Donggyun Lee, Su-Bom Kim & Seungchul Yoo



Article

16 January 2016 | Open Access

Spatiotemporally controlled drug release via a click-release system utilizing mono-alkyl hydroxylamine and cyclooxene chemistry

The advancement of bioorthogonal bond-breaking chemistry requires precise spatiotemporal control over chemical reactions. Here, the authors introduce a stimuli-responsive click-release platform based on the reaction between mono-alkylhydroxylamine and cyclooxene, enabling rapid and nearly complete payload release, and apply it to release of anticancer drugs and anaesthetics.

Xiaocui Xu, Xidan Tong & Yuehui Zheng

Article

16 January 2016 | Open Access

An artificial cell capable of signal transduction mediated by ADPR for the regulation of glycogenolysis

Signal transduction from extracellular to intracellular artificial cells is essential for autonomous artificial cells. Here the authors reconstitute a G protein-coupled receptor (GPCR) signaling pathway in an artificial cell to regulate downstream glycogen metabolism.

Yanhao Liu, Wen Zhao & Jiaquan Han

Article

15 January 2016 | Open Access

Selective electrosynthesis of urea from nitrate and carbon dioxide with low overpotential

Traditional urea production is energy-intensive and emits large amounts of CO₂. Here, the authors report an Ag/CdO catalyst with tandem dual sites that electrosynthesizes urea efficiently from nitrate and CO₂ by steering reaction pathways and suppressing by-products.

Shutao Liu, Tianyan Wang & Qing Li

Article

15 January 2016 | Open Access

Biodegradable Ni single atoms unlock high-rate microbial electrosynthesis of isopropanol from CO₂

The desaturation of CO₂ reduction electrocatalyst in microbial media remains a key barrier for hybrid bio-electrochemical systems. Here, the authors present a biodegradable nickel single atom catalyst that results organic poisoning to enable high-rate CO-mediated isopropanol production from CO₂.

Guangyu Zhou, Jonathan R. Humphrey & Zhenyong Jia

Article

15 January 2016 | Open Access

Mechanically guided residual learning for battery state monitoring throughout life

Ensuring accurate state monitoring is vital for battery safety and efficiency in electric vehicles. Here, authors present mechanistically guided residual learners that integrate mechanistic knowledge and machine learning to enable continuous, reliable battery state tracking over the entire lifespan.

Yunhong Che, Yuhang Zheng & Richard D. Braatz

Article

15 January 2016 | Open Access

Thioxide-conjugated covalent organic framework membranes enable ultraselective molecular desalination under strongly acidic conditions

Permeable and chemically stable membrane materials for molecular separation operating under harsh conditions are currently lacking. Here, the authors introduce a thiocarbonyl-based covalent organic framework membrane that enables the synthesis of chemically robust thiocarbonyl-linked poly(arylene ether sulfone) membranes via scalable for selective molecular separation.

Yao Luo, Songjun Jiang & Gang Han

Article

15 January 2016 | Open Access

A self-breathing electrode enabled by interface regulation and gradient wettability engineering for industrial H₂O₂ electrosynthesis

Gas diffusion electrodes enable electrochemical H₂O₂ production, but fused binders and disordered pores restrict mass transport. Here, the authors report a non-fused gradient catalyst layer that supports directional self-transport and stable high efficiency at industrial current densities.

We Tian, Luwei Fu & Zhenyong Jia

Article

15 January 2016 | Open Access

Classical criticality via quantum annealing

Superconducting quantum annealers have served as platforms for simulating condensed-matter phenomena. Satoh et al. use a quantum annealer to probe critical phenomena in classical magnets by reliably sampling thermal distributions, revealing universal signatures of phase transitions without classical simulations.

Pratik Satoh, Andrew D. King & Francesco Caraccioli

Article

15 January 2016 | Open Access

Reducibility of higher-order networks from dynamics

The topology of interactions is shaping dynamics of complex systems. Here, the authors develop a quantitative method to determine how much higher-order structure can be reduced without affecting dynamical behavior, revealing when higher-order interactions matter.

Maxime Lucas, Luca Gallo & Mariño De Domenico

Article

15 January 2016 | Open Access

4D printing through vat photopolymerization of two-stage UV-curable liquid crystal elastomers

Liquid crystal elastomers have potential as 4D-printing actuators, but it is difficult to achieve complex shape changes in structures. Here, the authors report a 4D-printing strategy that combines vat polymerization-based 3D printing with a two-stage UV-curable resin.

Huan Jiang, Christopher Chung & Kai Yu

Article

15 January 2016 | Open Access

Tailoring polarization homogeneity in discontinuous columnar Bi₂Te-MnO₂ thin films via dislocation engineering with controlled self-assembly

Controlled dislocation self-assembly is demonstrated in discontinuous columnar Bi₂Te-MnO₂ thin films. Guiding dislocations along grain boundaries tailors polarization homogeneity, revealing a microstructure-driven design principle for ferroelectrics.

Huiting Su, Wenhua Lou & Shujun Zhang

Article

15 January 2016 | Open Access

Robust water-activated tissue adhesive patch for arterial/heart wound closure after intervention surgery

Sealing of puncture points after interventional surgeries is a vital requirement, but large diameter sheaths and temporary punctures present a significant challenge for wound closure. Here, the authors present a water-activated tissue adhesive patch designed for quick and strong adhesion to blood vessel and heart tissue surfaces after surgery.

Yusuf Heng, Qianqian Zhu & Xuefeng Gou

Article

15 January 2016 | Open Access

A physics-informed graph neural network conserving linear and angular momentum for dynamical systems

Learning complex dynamics from data often leads to unstable or unphysical predictions. Here, the authors introduce Dynam-GAL, GraphNet, a physics-informed architecture that conserves linear and angular momentum and enables accurate robotics across diverse dynamical systems.

Vinay Sharma & Oleg Park

Article

15 January 2016 | Open Access

Increased electromagnetic interference shielding and load bearing with a three-dimensional pristine graphene@pyrocarbon skeleton in A219D

This work proposes an innovative method of 3D skeleton preconstruction-infiltration filling to construct a 3D pristine graphene@pyrocarbon skeleton in A219D, improving electromagnetic interference shielding and load bearing of the composites.

Yuan Ma, Lingjun Guo & Lihua Qi

Article

15 January 2016 | Open Access

Near-infrared-driven photocatalytic CO₂ reduction to C₂ hydrocarbons by bis(terpyridine)-metal functionalized lead halide frameworks

A family of bis(terpyridine)-metal functionalized lead halide frameworks is synthesized with both near-infrared absorption and charge-polarized sites, demonstrating efficient near-infrared-driven CO₂ photoreduction to C₂ hydrocarbon products.

Yukong Li, Ziyi Wang & Hongyan Fei

Comment

15 January 2016 | Open Access

Distributed multi-robot bio-inspired, biodegradable Lagrangian sensors for environmental sustainability

Biodegradable collections of Lagrangian sensors may enable sustainable mapping of environmental parameters. The authors evaluate bio-inspired designs, sensing targets, communication methods, power supply strategies, and future directions for these platforms.

Chanhui Park, Zhiming Hu & John A. Rogers

Article

15 January 2016 | Open Access

Dimensionality-dependent electronic and vibrational dynamics in low-dimensional organic-inorganic tin halides

The study shows that tuning organic-inorganic tin halides from 2D to 1D significantly enhances coupling between excitons and lattice vibrations, thereby switching emission from free excitons to self-trapped states. Ultrafast spectroscopy identifies the key electronic and vibrational dynamics.

Yanmei He, Ming Cai & Tiejun Fu

Article

15 January 2016 | Open Access

Light-driven restructuring generates nanoisland NiIr alloy for efficient methane dry reforming

Under light, nickel and iridium on the catalyst reconstruct into a nanoscale alloy that efficiently turn methane and carbon dioxide into synthesis gas, suggesting a promising way to recycle greenhouse gases.

Chengqian He, Ruijie Yang & Jinkang Zhang

Article

15 January 2016 | Open Access

Electrochemical desulfurization borylation of thiols, disulfides, thioethers and thioacetals

Low-valent sulfur-containing compounds are abundant among natural and synthetic products but remain underutilized as starting materials in desulfurization transformations. Here, the authors present thiols, disulfides, thioethers, and thioacetals as precursors in a direct desulfurization electrochemical process for the formation of alkylboronic esters.

Julius Kuzmin, Cristiana Margaria & Helena Lundberg

Article

15 January 2016 | Open Access

Construction of remote dual stereocenters by electrochemical cobalt-catalyzed enantioselective desymmetrization

The simultaneous construction of two constitutionally distinct stereogenic centers at remote positions in a single asymmetric catalytic step remains scarce, owing to the lack of reliable models for distant stereoselective induction for both chiral entities. Herein, the authors report an electrochemical cobalt-catalyzed asymmetric hydroacylation of enynes by a desymmetrization strategy that enables the enantio- and diastereo-selective construction of remote dual stereocenters.

Yanqun Li, Siyu Liu & Lutz Ackermann

Article

15 January 2016 | Open Access

Cluster level entropy enhancement in neutral acetate electrolytes enables economical and durable zinc air batteries

Conventional zinc-air batteries degrade rapidly in ambient environments due to corrosion/gasification in alkaline media. Here, authors design a neutral acetate electrolyte with entropy-enhancing molecules, which stabilizes the system and significantly extends battery lifetime.

Wenbin Zhao, Yi Wang & Zhongqun Chen

Article

14 January 2016 | Open Access

Domain wall motion-driven magnetic convolutional accelerator

The authors demonstrate a magnetic compute-in-memory platform that performs convolution using domain wall motion, enabling highly energy- and area-efficient processing for future AI hardware.

Bingqian Dai, Tianyi Wang & Kang L. Wang

Article

14 January 2016 | Open Access

Decoding the gradient-distributed colour centers in electrochromic WO₃

Multiscale electron spectroscopy reveals that gradient-distributed ions induce progressive lattice distortions from bulk to surface, driving redox in WO₃ electrochromic materials to transform into tetragonal and cubic phases and forming the gradient-distributed colour centers.

Sikang Xue, Jiehe Cui & Wandong Xing

Article

14 January 2016 | Open Access

Phase-controlled growth of 2D crystals of the MB₂T₂ family via a flux-assisted method

Van der Waals materials of the MB₂T₂ family (M = transition metal or rare-earth metal, B = Bi or Sb, T = Se, Te or S) have attracted interest for their magnetic and topological properties, but their direct synthesis into 2D form remains challenging. Here, the authors report a flux-assisted phase-controlled growth strategy to directly grow six magnetic 2D MB₂T₂ crystals.

Xingqiao Wang, Shijie Wang & Yongxiang

Article

14 January 2016 | Open Access

Quantum suppression of cold reactions far from the s-wave energy limit

Recent efforts in ion-atom collisions predicted and partially observed the occurrence of quantum features such as partial wave phase locking at higher temperatures. Here, the authors demonstrate the occurrence of quantum interference in charge exchange reactions.

Or Katz, Mordechai Finkels & Roni Zeevi

Article

14 January 2016 | Open Access

Solvent-mediated partial ionicity enhances mechanical nanosizing effect of the based hydrogen storage alloys

The work highlights the role of solvent-mediated ionics in modifying surface hardness of Mg-Ni-Y alloy, which facilitates the production of nanoparticles ~88 times smaller than milled powder without solvent processing, resulting in a scalable production method for metallic nanoparticles.

Tianping Sun, Zhengjie Tang & Yungang Lu

Article

14 January 2016 | Open Access

Antireversibly confined interfacial self-assembly approach for the synthesis and characterization of nanofilms

Gratification-induced disaffiliation during self-assembly often leads to density driven vertical segregation limiting the synthesis of metastable nanofilms. Here, the authors address this limitation with an antireversibly confined interfacial self-assembly synthesis where capillary forces dominate and enable precise molecular organization resulting in ordered and stable nanofilms.

Zhaohui Zhou, Jinmei Lei & Xu Hou

Article

14 January 2016 | Open Access

A reconfigurable photosensitive split-floating-gate memory for neuromorphic computing and nonlinear activation

AI-in-one computing, which merges sensing, linear computing, and nonlinear activation, is a critical goal for next-generation AI hardware. Here, Zhang et al. introduce a high-speed, reconfigurable split-floating-gate memory, enabling multi-function integration within a unified platform and hardware native neuromorphic processing.

Zhi-Cheng Zhang, Yuan Li & Xu-Dong Chen

Article

14 January 2016 | Open Access

Regulating zinc nucleation and growth with low-surface-tension electrolytes for practical aqueous zinc metal batteries

Rechargeable zinc batteries are promising for grid energy storage but can suffer from short circuits and side reactions. Here, the authors design low-surface-tension electrolytes that enable dense, dendrite-free zinc deposition, achieving long-lasting batteries even under harsh operating conditions.

Huan Wang, Gaofei Li & Zhen-Zhong

Article

14 January 2016 | Open Access

Synthetic gain for electron-beam spectroscopy

The work introduces synthetic gain to electron-beam spectroscopy, greatly enhancing spectral resolution and revealing hidden features, enabling advances in nanoscale analysis and electron-beam-based quantum optics under challenging signal conditions.

Yongliang Chen, Fabio Zeng & Yi Yang

Article

14 January 2016 | Open Access

Chronically implantable LED arrays for optogenetic cortical surface stimulation in mice

Achieving high-resolution optical neural interfaces is challenging. Here, the authors developed and chronically implanted 100- μ m pixel micro-LED arrays on the surface of the mouse auditory cortex for optogenetic behavioural experiments.

Ryan Oliver, Antoine Veiller & Keith Muthusamy

Article

14 January 2016 | Open Access

Growth of iron-layered 2