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Electrochemical speciation enhanced by C-dC activation and hydroxyl conversion at the Au/SnO2 interface
Electrochemical CO2 reduction is mainly hindered by the sluggish activation of CO2 and poor selectivity of multi-carbon products. Here, we report that Au and SnO2 heterojunctions can promote the adsorption and dissociation, TS1 generation, leading to preferential production of ethylene oxide.
Wei Zhang, Yuan Liu, Bin Liu, Zhi Li

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Precise control of nanocrystallinity with a laser accelerated high-energy electron radiofrequency generator
Radiofrequency (rf) guns are a promising technology for compact accelerators for future ultrafast electron diffraction, X-ray free electron lasers, and inverse Compton scattering sources. Ultrafast and high energy laser wakefield accelerators have recently reached the efficient electron bunches required for rf gun operation.
Vincent Dias, Rasmus Ischebeck, Carl B. Schroeder, Eric Esarey, Jens Osterhoff

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Coupling of electronic transitions to ferroelectric order in a 2D semiconductor
Ferroelectric materials are characterized by spontaneous electric dipoles that can be switched by an applied electric field. Coupling between electronic excitations and the electronic dipoles gives rise to optical phenomena such as second harmonic generation and electro-optic effects.
Chris Fei Zhang, Kenzo Ji, Chris D. Malliakas, Dy Tu

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A tunable uncoupled cylindrical pole source based on a low-loss Weyl-semimetal
Uncoupled sources of electromagnetic radiation are a key component in many technologies, including computing, communications, and sensing. Time-harmonic high-energy electromagnetic sources with tunable frequency, polarization, and spatial profile are desirable for many applications.
Ivan Dimitrakakis, Ivan Maksimov, Yuri S. Kivshar

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Dynamic nanosecond liquid-liquid interface phase transition in water-in-fluorinated oil droplets for flowing protein heterogeneity assay
Liquid-liquid phase separation can alter the properties of protein and biomolecule properties, but can be challenging to detect and study in high throughput and in dynamic environments. Here, we use droplet microfluidics to study liquid-liquid phase separation of lysozyme.
Hsiao Chien, Zhengxin Liu, Ke Chih Fung

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Achieving beta-1,3 glucan-like nanofibrils from oligomeric fluorinated neural organic framework modulation functionalized interface
Neural organic nanofibrils are a promising material for future the practical use of 1-dimensional (1D) organic nanofibrils, which are expected to be used in various fields such as electronic devices, electric actuators, and electric stimulators and in 1D ionic-type and as an electronic insulator.
Chaeyeon Kim, Tae Ho Ahn

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Rational design of perovskites and controlled evaluation of catalytic electrolyte interface for efficient hydrogen production
Electrolysis of water is a promising approach for hydrogen production, but the lack of efficient electrocatalysts is a major other contributed. The optimal region of efficient electrolyte-metal catalyst interfaces, which is critical for the rational design of efficient electrocatalysts and electrolyzers, remains unknown.
Chaoran Zhu, Lei Zhao, Bi Shuai Zhang

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High-fill-in, ps-production in membrane-free electrolyzer cells by bubble-induced microfluidic shedding towards robust real electrolysis
The successful demonstration of a 10 L, 24 hour-long experiment for electrolyzer membranes, then the electrolyzer cell, and the electrolyzer cell, and the electrolyzer cell, and

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Hemiphosphoindigos as a platform for chiroptical or water soluble photoswitching

Photoswitches are useful in a range of applications, with designing molecules with desirable properties remaining a key challenge. Here, the authors report hemiphosphoindigo chromophores enabling chiroptical and in-water photoswitching with high thermal stabilities, fatigue resistance and isomer enrichment in the photostationary state.

Fabien Kohl, Theresa Vogl & Henry Dube

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The inherent adversarial robustness of analog in-memory computing

Adversarial attacks threaten deep neural networks. Here, authors show analog in-memory computing chips enhance robustness, attributed to stochastic noise properties. This is validated experimentally and in simulations with larger transformer models.

Corey Lammie, Julian Büchel & Abu Sebastian

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Boosting mechanical durability under high humidity by bioinspired multisite polymer for high-efficiency flexible perovskite solar cells

Poor mechanical stability under high humidity remains a critical challenge for flexible perovskite solar cells. Here, the authors develop a bioinspired dopamine containing polymer to enhance adhesion in humid environments, achieving an efficiency of nearly 26%.

Zhihao Li, Chunmei Jia & Zhen Li

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Minimized optical/electrical energy loss for 25.1% Monolithic perovskite/organic tandem solar cells

The performance of perovskite/organic tandem solar cells remains hampered by the energy losses of subcells and interconnecting layers (ICLs). Here, authors introduce pyridinium bromide perbromide into perovskites and employ a V_2O_5-based ICL, achieving a maximum efficiency of 25.1% in tandem devices.

Zhangwei He, Runnan Yu & Zhan'ao Tan

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Reversible long-range domain wall motion in an improper ferroelectric

The authors find the electric-field-driven motion of domain walls in the improper ferroelectric $ErMnO_3$, showing that they readily return to their initial position after having travelled distances exceeding 250 nm.

Manuel Zahn, Aaron Merlin Müller & Jan Schultheiß

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Parafermions in moiré minibands

Parafermions hold promise as building blocks for topological quantum computers but have remained experimentally elusive. Here, the authors employ numerical calculations to demonstrate that parafermion excitations can emerge in partially filled moiré minibands of twisted multilayer graphene systems.

Hui Liu, Raul Perea-Causin & Emil J. Bergholtz

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AI-based approach to dissect the variability of mouse stem cell-derived embryo models

Stem cell-derived embryo models offer insights into early development but suffer from variability. Here, authors used AI to classify and predict outcomes for generation of mouse stem cell-derived embryo-like structures, improving selection accuracy and understanding of self-organization.

Paolo Caldarelli, Luca Deininger & Magdalena Zernicka-Goetz

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Realizing four-electron conversion chemistry for all-solid-state $LiI|I_2$ batteries at room temperature

Current LiI|I2 batteries suffer from limited capacity and polyiodides shuttling. Here, authors showcase a four-electron all-solid-state LiI|I2 battery using a chloride-rich solid electrolyte that enables a solid-phase reversible $I^-/I_2/I^+$ conversion, achieving high capacity and enhanced safety.

Zhu Cheng, Hang Liu & Haoshen Zhou

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Additive manufacturing of water-soluble 3D micro molds for complex-shaped lipid microparticles

Micro and nanoparticles can be prepared from a number of materials and find use in a number of applications, but preparation methods can lead to undesirable shapes. Here, the authors report the development of a 3D printing method for the preparation of lipid microparticles.

Jongeon Park, Juergen Brugger & Arnaud Bertsch

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Implantable photoelectrochemical-therapeutic methotrexate monitoring system with dual-atomic docking strategy

Concentration of methotrexate (MTX) in the blood needs precise monitoring. Here, the authors propose an atomic-molecular docking strategy that utilizes a hybrid-dual single-atom Fe_1-Zn_1 on TiO_2 photoelectrode to bind to the carboxyl and aminopyrimidine groups of MTX.

Xiankui Xu, Dawei Xu & Zhonghai Zhang

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Highly selective upcycling of plastic mixture waste by microwave-assisted catalysis over Zn/b-ZnO

Traditional catalytic methods for recycling plastic often suffer from reduced efficiency and high energy demands. Here, the authors demonstrate a highly efficient and rapid process for depolymerizing plastic waste into valuable monomers and lubricant base oil precursors using microwave-assisted catalysis with Zn/b-ZnO under mild conditions.

Jun Zhao, Bonan Liu & Junwang Tang

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Towards the quantized anomalous Hall effect in AlO_x-capped $MnBi_2Te_4$

The challenges in reliably reproducing the quantum anomalous Hall effect have emerged as a major bottleneck for $MnBi_2Te_4$. Here, the authors develop a fabrication method to address this, paving the way for the fabrication of high-quality dissipationless topological transport devices.

Yongqian Wang, Bohan Fu & Chang Liu

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Phase transformation in lead titanate based relaxor ferroelectrics with ultra-high strain

Erbium-doped lead magnesium niobium titanate ceramics demonstrate ultrahigh strain and piezoelectric coefficients under low electric fields, setting a benchmark for piezoelectric materials and offering versatile applications in precision actuators and sensors.

Hangfeng Zhang, Zilong Li & Lei Su

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Sustainable pest management using plant secondary metabolites regulated azadirachtin nano-assemblies

The stability and delivery of biopesticides limits application. Here, azadirachtin is co-assembled with plant secondary metabolites for efficient drug delivery, demonstrating pest management, the activation of plant defensive capacity, while increasing the production yield of crops.

Xiaohong Zhang, Jianhua Xiao & Yongsong Cao

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Effectiveness of strain and dopants on breaking the activity-stability trade-off of RuO_2 acidic oxygen evolution electrocatalysts

Ruthenium dioxide electrocatalysts for acidic oxygen evolution suffer from mediocre activity and poor stability due to high ruthenium–oxygen covalency. Here, the authors report the effectiveness of tensile strain and electronic dopants in improving both activity and stability.

Yang Liu, Yixuan Wang & Hyoyoung Lee

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Theory of correlated insulators and superconductor at $\nu = 1$ in twisted WSe_2

Recently, superconductivity intertwined with an insulating phase at a commensurate band-filling was discovered in twisted bilayer WSe_2. Here, the authors theoretically propose that the observed insulating state may be a quantum spin–liquid Mott insulator with electron fractionalization, separated from the superconductor via a quantum phase transition.

Sunghoon Kim, Juan Felipe Mendez-Valderrama & Debanjan Chowdhury

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A biodegradable and restorative peripheral neural interface for the interrogation of neuropathic injuries

Monitoring the early-stage healing of severe traumatic nerve injuries is essential to gather pathological information for timely interventions. Here, the authors introduce a biodegradable and restorative neural interface for wireless real-time tracking.

Liu Wang, Tieyuan Zhang & Lan Yin

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Supramolecular rosette intermediated homochiral double helix

Elucidating the hierarchical assembly process is fundamental to the understanding of chirality transfer and chiroptical functions. Here, the authors show that a bisurea molecule self-assembles into chiral double-helices by a supramolecular rosette intermediated hierarchical assembly mechanism.

Tiejun Li, Dian Niu & Minghua Liu

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Autonomous platform for solution processing of electronic polymers

Efficiently processing electronic polymer solutions into thin films with targeted properties is challenging. Here the authors employ Polybot, an AI-driven automated lab, to autonomously explore pathways for high-conductivity, low-defect polymer films.

Chengshi Wang, Yeon-Ju Kim & Jie Xu

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Adaptative two-phase thermal circulation system for complex-shaped electronic device cooling

Thermal management in compact electrical devices is challenging due to limited space and complex geometries. Here, the authors present a flexible heat pipe that conforms to arbitrary shapes without space constraints, achieving an ultra-high thermal conductivity of 11,363 W/m·K.

Wenjun Xu, Jiarong Cui & Wei Zhou

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