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High entropy RuO_2 catalyst with dual-site oxide path for durable acidic oxygen evolution reaction

Developing efficient and durable oxygen evolution reaction catalysts is crucial for proton exchange membrane water electrolysis. Here, the authors report a nanocrystalline high entropy oxide for this reaction, by activating a lattice oxygen oxidation at a dual-site for the catalyst.

Yuhang Wang, Yanbing Guo & Shibin Shang

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Programming of refractive functions

Despite the diversified, arbitrary programming of light reflection through gradient metasurfaces, the realization of refractive functions remains challenging. Here, the authors propose a universal approach to program refractive functions.

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Dual bound fracture metamaterials with full-field extrinsic toughening

Fracture toughening is a challenge for metamaterials. Here, the authors report a dual bound fracture metamaterial that realizes the full-field toughening. Experiments, simulations and theoretical analysis show a combination of intrinsic and extrinsic toughening mechanisms.

Chenglong Liu, Hongbo Ma & Yin Wei

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Maximized circularly polarized luminescence through molecular assembly acceleration: clinical thrombus diagnosis

The applicability of the circularly polarized luminescence quantified from chiral substances is limited by the inherently low dissymmetry factor. Here, the authors report a strategy to maximize the circularly polarized luminescence through molecular assembly acceleration.

Chang Zhao, Yuxi Gao, Ji Huang, Guan Zeng

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Terahertz control of linear and nonlinear Mamyshev photonics

It is generally assumed that transmitting magnetic properties can mean excitations of magnetization precession. Here, the authors show that this is not the case and that the transmitting magnetic properties are a consequence of intrinsic nonlinear effects and Mamyshev, not Kerr-type nonlinearity.

Yuanchang Liu, Hongbo Ma & Yin Wei

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Dual gradient metal layer for practicalizing high-energy lithium batteries

Lithium metal batteries are plagued by dendrite growth and limited cycle life. Here, the authors report a dual gradient metal layer to practicalize high-energy lithium batteries with high areal capacity and long cycle life.

Mengyu Yan, Fangchao Qian & Huaiyu Wang

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Enantioselective synthesis of chiral 2,3-cis-disubstituted oxetanes and 1,4-substituted tetrahydroisoquinolines by asymmetric Cu-catalyzed reductive aminoboration

Chiral 2,3-cis-oxetanes and 1,4-substituted tetrahydroisoquinolines are privileged structural motifs in medicinal chemistry. Here, the authors report the synthesis of these compounds by asymmetric Cu-catalyzed reductive aminoboration of allenes with hydroxylamine esters.

Dachuang Zhang, Hui Yang & Wenjun Tang

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Nanoelectric dual-comb ranging using ultrafast terahertz microcavity solitons

Dual-comb ranging is a powerful technique for high-precision long-range metrology. Here, the authors demonstrate dual-comb ranging using a single ultrafast terahertz microcavity soliton source, which is a promising approach for compact, high-precision, long-range metrology with a potential for power requirements by over 50 dB.

Chao Zhang, Yan Peng & Hongqiang Zhai

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Integrating 5-carbene photocatalysis with tandem carboxylation: A green and scalable strategy for CO_2 valorization

Here, the authors report a photocatalytic strategy for the synthesis of 5-carbene intermediates from diazirines and carboxylic acids. The approach offers a green, scalable route for carbene generation and subsequent carboxylation.

Yuanyuan Li, Yuhui Zhao & Jianmingzi Kuang

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Force-light-heat stimulation induced multicolor chromotropism and multifunctional application of corrosion compounds

Mimicking responsive color and luminescence changes over the multiple organs in chameleon, here the authors report a force-light-heat stimulated chromotropic microfiber under daily light and heat for sensing and chemistry applications.

Yingbo Liu, Ruyue Huang & Zhongwen Ying

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Dispersity-controlled ring-opening polymerization of cyclosiloxanes

Ring-opening polymerization of cyclosiloxanes usually results in polymers with narrow dispersity. Here, the authors report a ring-opening polymerization of cyclosiloxanes that can control dispersity to arbitrary values reaching the theoretical maximum of ring-opening polymerization of cyclosiloxanes.

Yuan Zhou, Guoming Zhao & Zhiqiang Wang

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Structured origins of Fano resonance induced surface changes in piezoelectric pharmaceutical crystals for engineering bulk properties

Surface changes in crystalline materials is a complex phenomenon in pandemic and design. Here the authors report the origin of Fano resonance induced surface changes in piezoelectric pharmaceutical crystals for engineering bulk functionalities.

Nicholas Tung, Sahil Gulani & C. Vinod Reddy

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^{129}Xe and ^{13}C nuclear resonance vibrational spectroscopic characterization of intermediate spin-state mixed-valent dimers

Here, the authors report the characterization of a mixed-valent diiron dimer with intermediate spin-state iron centers by nuclear resonance vibrational spectroscopy and density functional theory calculations.

Valerie Mathe, Lauren E. Goodrich & Serena DeBeer

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Integrating physics and topology in neural networks for learning rigid body dynamics

Neural networks have been successful in learning physical systems from observations. Here, the authors propose a physics-informed neural network using topological priors for learning rigid body dynamics with exact conservation laws and symmetries.

Seungwoong Ha, Wonseok Jeong & Hawoong Jeong

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Training a high-performance retinal foundation model with half-the-data and 400 times less compute

Developing models for medical research is challenging due to significant resource requirements and data access restrictions. Here, the authors show that a foundation model for retinal images can be trained with significantly less data and compute while maintaining performance on par with the original model.

Justin Engelmann & Miguel O. Bernabeu

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Optically programmable quasi-phase matching in fiber wave mixing

Quasi-phase matching enhances nonlinear optics but typically requires fixed material structures. Here, the authors demonstrate optically programmable quasi-phase matching in optical fibers enabling broadband, tunable wavelength conversion and other nonlinear optical functions.

Jie Li, Yuan Gao, Jiaxiang Zhang & Jing Zhang

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Self-adaptable mechanical ceramic fibrous aerogels from precrosslinked topology and multistable constraints

Ceramic fibrous aerogels inherit unique properties but fail by integrating ceramic polymerization and fiber assembly. Here, the authors report a multistable ceramic fibrous aerogel with high strength, fracture energy, and fatigue resistance.

Chengbing Wang, Hongqiao Wang & Haiyan Wang

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Electromagnetic dynamic stability analysis of power electronics-dominated systems using eigenvectors-aware perturbed ELTP theory

Electromagnetic dynamic stability analysis of power electronics-dominated systems is challenging. Here, the authors propose an eigenvectors-aware perturbed ELTP theory that enables the eigensensitive analysis of electromagnetic dynamic stability.

Yicheng Liu, Zexiang Cai & Yijiang Cheng

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Unmotivated soft microrobot driven by a single actuator for safe manipulations

Replicating the soft navigation and robustness of motivated, or undirected, microorganisms is challenging. Here, the authors report a soft microrobot with a single actuator, achieving both gait variety and robustness after being trapped in a...

Yi Feng, Wu Jin Ge & Bin Zhang

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Ferroelectric NAND for efficient hardware bayesian neural networks

Bayesian neural networks is a machine learning architecture designed to capture the uncertainty in predictions. Here, the authors report a ferroelectric NAND array for implementing Bayesian neural networks and the inherent stochasticity of its switching.

Yu Li, Yi Yang, Yuchao Yang & Ru Huang

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Detecting deformation mechanisms of metals from acoustic emission signals through knowledge-driven unsupervised learning

Acoustic emission is a powerful technique for monitoring deformation mechanisms in metals. Here, authors develop an unsupervised learning framework for analysis of acoustic emission signals, enabling the identification of deformation mechanisms in metals.

Wuyuan Feng, Han Chen & Hongliang Ding

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Convective dynamics in mantle of tidally-locked exoplanets

Tidally-locked exoplanets have a permanent dayside and nightside forming a super-rotation jet. Here, the authors show that super-rotation is enabled by a thermal tide dynamic, the dayside-to-nightside flow driven by the temperature contrast, and the Coriolis force, which is responsible for the jet.

Cesare Guilet, Thomas Gastine & Ujjwal Rei

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Quantum anomalous Hall crystals in moiré bands with higher Chern number

Quantum anomalous Hall crystals are exotic phases that host the quantum Hall effect without external magnetic fields and Landau levels. Here, the authors predict quantum anomalous Hall crystals with higher Chern number in twisted bilayer graphene.

Shuai-Feng Zhang, Jian Kang & Jie Wang

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Evolution neural networks via higher-order interactions in curved statistical manifolds

Higher-order interactions in neural networks have been shown to play a key role in their dynamics and information processing capabilities. Here, the authors propose a framework for studying these interactions in curved statistical manifolds, revealing evolution-driven transitions and phenomena hidden in the...

Miguel Aguilera, Sarah E. Marzen & Masayuki Ohzeki

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Nanoscale size effects in 4 $CaFeO_3$ evinced by large-scale ab initio simulations

A vital point in the thermodynamics of nanoscale materials pertains to the dependence of their properties on particle size. Here, the authors report the size dependence of the energy and equilibrium crystal shape of $CaFeO_3$ nanoparticles.

Chaitanya Kumar Ganamala, Ivano E. Castelli & Nicola Marzari

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Nanowires expanding the boundaries of biocatalysis

Biocatalysis is increasingly employed as a green and sustainable application, and the development of novel biocatalysts is a key challenge in the field of biocatalysis and biotechnology. This review explores the fundamental definitions and distinctive characteristics of nanowires, and their potential applications in biocatalysis, including their synthesis and applications.

Lei Zhang, Yuan Lu & Yi Cao

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Interconvertible and rejuvenated Li-rich acidic electrolyte additive for fast-electrolyte lithium sulfur batteries

Lithium sulfur batteries are plagued by the polysulfide shuttle and the inevitable Li metal anode corrosion. Here, the authors report a Li-rich acidic electrolyte additive, which can simultaneously address the issues of the Li metal anode and the sulfur cathode.

Yuan Gao, Yuhang Li & Yi Cui

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Room-temperature quantum metric effect in $TlBiSe_2$

Quantum metric is a new concept arising from the quantum realm, has been reported in superconductors and magnetic materials. Here, the authors report the quantum metric and nonlinear optical responses in the bulk of $TlBiSe_2$ at room temperature, which are theoretically predicted and experimentally verified by applied magnetic field.

Chaowei Zhou, Yuanbo Liu & Yi-Yan Yang

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Multivariate metal-organic frameworks enable chemical-shift-encoded MRI with femtomolar sensitivity for biological systems

Chemical-exchange MRI has the signal intensity limit in its applications. Here, the authors report a multivariate metal-organic framework that enables chemical-shift-encoded MRI with femtomolar sensitivity.

Chaoqin Zhang, Yuanyi Wang & Yi-Xian Qin

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Nanofibrillated collagen fiber networks for enhanced air purification

Air pollution is a serious problem that threatens human health. Here, the authors report a nanofibrillated collagen fiber network for air purification. Owing to its ultrafine fiber diameter and high porosity, the network exhibits high filtration efficiency and low pressure drop.

Li-Chong Xing, Xiaoyi Huang & Yingjie Cai

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Nanowrinkle plays for fatigue-resistant bloodlessness and interfacial biomineralization

Here, the authors report a nanowrinkle play for fatigue-resistant bloodlessness and interfacial biomineralization. The nanowrinkle play can enhance the fatigue resistance of the bone implant and promote bone integration to wearable devices for chronic disease. Here, the authors report the nanowrinkle play for fatigue-resistant bloodlessness and interfacial biomineralization.

Shaohong Wang, Hao Jin & Haimin Li

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Direct atomic-scale investigation of the coarsening mechanisms of exsolved catalytic Ni nanoparticles

Exsolution enables the formation of active catalytic nanoparticles, but their thermal stability remains a challenge. Here, the authors investigate the coarsening mechanisms of exsolved Ni nanoparticles by scanning transmission electron microscopy.

Dario Ferreira Sanchez, Dmitry E. Ferri & Wolfgang Pfleiderer

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High-precision time-domain stereoscopic imaging with a femtosecond electro-optic comb

Stereoscopic imaging relies on known baseline viewing and often requires accurate depth maps. Here, the authors demonstrate time-domain stereoscopic imaging without the need for a baseline, and without depth maps, by leveraging a femtosecond, dual-comb system.

Zach Nelson, Yu-Hsi Chang & Nathan R. Newbury

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Scalable 3D reconstruction for X-ray single particle imaging with online machine learning

Single particle imaging with X-ray free electron lasers (XFELs) has a large potential to study structure and dynamics of nanoscale samples in their native environment. The technique however, is experimentally challenging, paired with a large computational burden.

Jay Shenoy, Kartik Ayyer & Carlos Hernandez

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Self-assembling solid Sb electrode enables high-capacity, low-cost Cs-ion battery

Cs-ion batteries are promising candidates for large-scale energy storage applications due to their low cost. Here, authors use a liquid-based approach to synthesize Sb nanoparticles and self-assembled them into a solid electrode for Cs-ion batteries.

Jiangtao Hu, Yanchen Lu & Jiaxin Zheng

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Muscle-inspired elastic electromagnetic mechanism to autonomous insect robots

Flexible electromagnetic actuators have been developed for soft robots. However, existing materials normally restrict the energy attainment, material and magnetic forces. The authors achieved a muscle-inspired elastic electromagnetic mechanism to autonomous insect robots with large energy density.

Chengbin Yu, Yajing Shen & Yanlong Zhang

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UCP2 inhibitor ameliorates pancreatic β cell autoinflammation in T2DM with islet mitochondrial sequestering nanomedicine

Pancreatic β cell autoinflammation is a hallmark of pathogenesis and progression of T2DM in obesity. Here, the authors show that the use of a mitochondria-DNA-sensitive Mn-Cu-based autoinflammation nanomedicine can inhibit the activation of the cGAS-STING pathway and ameliorate T2DM progression.

Yuan Li, Wenchang Zhao & Yanlong Tan

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Lateral mark variations induce shift in ice's peak tilted heating

An embedded air channel slows ice sintered with air scattered by solid particles, causing the ice to heat unevenly and tilt toward the particles, a finding that could help explain how ice sheets flow and melt.

Yuki Nakamura, Hiroshi Tanaka, Kenji Watanabe

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Latest Research

High-strength and plasticity in disordered multilayer graphene reinforced copper composites

Researchers have created a strong, durable nanomaterial by stacking sheets one atom thick between layers of copper. The material can withstand extreme forces without breaking, which could lead to stronger and lighter components for aircraft and spacecraft.

Yongsheng Zhang, Xiaoxu Li, Zhang Jie, Ning Wang, Kaiyuan Ma

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Stereoselective positional alkene isomerization enables bidirectional control-to-axial chirality transfer

Mirror-image molecules are important in a wide range of fields, from medicine to materials science. Researchers have developed a new method that can selectively produce either one of two mirror-image forms of a molecule, allowing access to entirely new drug candidates.

Elias Vanderlinden, Mei Chen, Rafael Ortiz

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Topology meets time reversal symmetry-breaking in YCo$_{6-x}$Ge$_{6+x}$ superconductors

Researchers have discovered a new superconducting material, YCo$_{6-x}$Ge$_{6+x}$, that combines two exotic properties: it conducts electricity without resistance and its electrons behave like they have no mass. The material could help scientists build more powerful and efficient quantum computers.

Yongkang Li, Zhiwei Qin, Hao Chen, Jian-Xin Zhu, Shuai Wang

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Latest Research

Ultrasensitive label-free optical recording of biodynamic proteome using discriminative-based electromeric polymers

Researchers have developed a new type of plastic that can detect and record tiny electrical signals from living cells with unprecedented sensitivity. The material can capture brain activity and heart rhythms without damaging the cells, opening new possibilities for studying how the body and brain work.

Yu-Cheng Chiu, Hsin-Ju Lee, Wei-Ting Kuo, Jonathan Ho

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Broadband emission for near-generation integrated photonic FWCW LIDAR sources

Researchers have developed a new type of laser that can measure the distance to objects with extreme precision, even in bright sunlight. The device could help self-driving cars and robots see their surroundings more clearly and safely, and may find applications in satellite communications and scientific instruments.

Chen Wei, Rajesh Kumar, Li Ming-Hua, Sofia Andersson

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Theoretical and quantum-mechanical deconstruction of vibrational energy transfer pathways modified by collective vibrational strong coupling

Researchers have found a way to control how energy moves through molecules by placing them inside a tiny optical cavity. This discovery could lead to more efficient solar cells and new ways to power chemical reactions using light.

Ivy Sun, Li Zhang, Jun Yi, Ivan M. Alvarez

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Unravelling emergence of chirality in chiral-chemistry polymers down to the single-chain level

Researchers have created a new type of plastic that can store and release energy like a battery. The material can be recharged hundreds of times without losing much power, and could lead to lighter, more flexible batteries for different kinds of devices.

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Yuki Tanaka, Hiroshi Mori, Ji-Woong Na Park

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Yuki Tanaka, Hiroshi Mori, Ji-Woong Na Park

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Yuki Tanaka, Hiroshi Mori, Ji-Woong Na Park

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

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