

Science Newsletter

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Introduction:

There are 3 main elements in the Science Newsletter which is composed. In the first part, we list the most up to date papers about central issues for each discipline in our university, and they are provided with 5 subjects for a time. In the second part, there are papers from the top journals last month, and most of them are from Nature and Science. In the third part, we post information about calling papers for international conferences. Hopefully, some of the information in this manuscript may be useful for those who are dedicating to scientific career. Besides, the journals are also posted on the website of our library, and they are available to be accessed any time at <https://lib.jsut.edu.cn/2025/0228/c5474a193334/page.htm>. If there are any questions or suggestions, please send e-mails to ccy@jsut.edu.cn in no hesitate.

I Topics

The keywords of this month is **Materials**:

We post several papers which are related to the top concerned topics of researches on Materials Science. The papers are classified in 5 categories, and they are: **Ceramics**, **Composite materials**, **Amorphous Materials**, **Nanomaterials** and **Biomaterials**. Also, the listed papers are all arranged in a descending sort of JCR impact factor. If you want full pages of these papers, please contact us for help.

CERAMICS

Nat Commun (impact factor: 15.7) 1

Modulating physicochemical interfaces enables li-rich oxides based ceramic solid-state li batteries under ambient conditions

Xinchao Hu, Shuqi Shen, Jiantao Li, et. al

Abstract:

Li-rich layered oxides exhibit promising potential applications in high-energy-density solid-state lithium metal batteries. Nevertheless, the strong oxidative oxygen species generate at high voltage, which poses great challenges to positive electrode-side

interface stability. Herein, a robust in-situ polymerization gel polymer electrolyte with bifunctional additives is designed for interface modification. These additives, include lithium difluoro(oxalate) borate and LiPO_2F_2 , regulate the Li^+ chemical environment in gel polymer electrolyte to enhance crosslink density without residual oligomer, which reduce gas generation and suppress contact loss, thus avoiding interfacial impedance divergence. Concurrently, the designed gel polymer electrolyte enables a wide electrochemical stability window (up to 4.7 V) and a high Li^+ transference number (0.82). Additionally, the additives induced F- and B-rich inorganic cathode-electrolyte interphase inhibits side reactions and oxygen/transition metal loss effectively, stabilizing the chemical interface. The as-constructed Li-rich layered oxides-based ceramic solid-state lithium metal batteries with gel polymer electrolyte interface modification exert a high discharge capacity of 276.5 mAh g^{-1} at 30°C without external pressure, delivering a retention of 81.7% after 100 cycles at 25 mA g^{-1} during 2.0-4.7 V. This work provides a guideline for developing high-voltage solid-state lithium metal batteries via interfacial design.

J Hazard Mater (impact factor: 11.3) 1 [X](#) TOP

Effect of thermoplastic polyurethane filament on the cellular ceramics structures obtained from material extrusion and polymer-derived ceramic

Apoorv Kulkarni, Louisa Eckey, Liu, et. al

Abstract:

Cellular ceramic structures were fabricated via 3D printing of thermoplastic polyurethane (TPU) followed by impregnation with polysilazane, and pyrolysis. The 3D printing was performed using fused filament fabrication (FFF), while the ceramic was obtained through the polymer derived ceramic (PDC) process starting from a commercially available polysilazane, Durazane 1800. We investigated the role of ester- and ether-based TPUs with two different Shore hardness (90A vs 80A) on the impregnation of polysilazane. Regardless of the TPU type and Shore hardness, impregnation of the TPU 3D structure was successful and resulted in dense, non-hollow ceramic struts after pyrolysis. All polyester- and polyether-based TPUs showed a similar mass and volume increase after impregnation with high deviation. The mass loss during pyrolysis was also very similar for all the TPUs. The behavior of these TPUs was then compared with one commercial TPU filament (Ninjaflex with a Shore hardness of 85A). While the Ninjaflex 3D-printed structures showed a greater increase in mass and volume after impregnation, the pyrolysis outcome was almost identical to that of the samples fabricated with both ester- and ether-based TPUs, resulting in dense, non-hollow ceramic struts.

pH-Mediated Dual-Phase Equilibrium Manipulation and Microstructural Optimization of Y₂O₃-MgO Composites for Enhanced Mid-Infrared Transparency.

Xincheng Cai, Junjing Duan, et. al

Abstract:

Y₂O₃-MgO composites are promising mid-infrared transparent materials for extreme environments. However, their optical and mechanical properties are limited by microstructural imperfections, including non-ideal phase fractions, excessive grain growth, and inhomogeneous phase distribution. Conventional coprecipitation struggles to synchronize precipitation of Y³⁺ and Mg²⁺ due to their divergent solubility products, leading to compositionally segregated nanopowders and degraded ceramic performance. To address this, we developed a coprecipitation-solvothermal coupling process with precision pH control (9.31-11.56) to manipulate dual-phase equilibria and microstructure. This strategy enhanced supersaturation to accelerate conucleation (via the Gibbs-Thomson effect), enabled complete Mg²⁺ precipitation at high pH (≥ 10.84), and achieved atomic-scale precursor homogenization. The pH-optimized nanopowders produced hot-pressed ceramics with a nearly perfect 1:1 phase volume ratio, ultrafine grains (129 ± 4 nm), and high phase homogeneity ($\alpha_f > 0.9$). These yielded excellent properties: 85% maximum transmittance at 6.2 μm (79% at 7 μm , the highest reported values), the broadest cutoff window (1.0-11.5 μm , approaching theoretical limits), and enhanced hardness (11.19 GPa) with toughness (2.43 MPa m^{1/2}). This work introduces pH-mediated phase equilibrium control as a universal paradigm for designing high-performance oxide composites. By resolving fundamental precipitation mismatches, it establishes a general pathway for microstructural optimization in multifunctional ceramic systems.

COMPOSITE MATERIALS

Bioinspired Hierarchical Radiative-Phase Change Hybrid Cooling Composite with Record-Breaking Cooling Power.

Xinpeng Hu, Bingqing Quan, et. al

Abstract:

Passive daytime radiative cooling (PDRC) offers a sustainable route to reducing cooling energy consumption and greenhouse gas emissions. However, conventional PDRC materials exhibit limited cooling power (< 150 W m⁻²), insufficient for growing cooling demands. While integrating phase change materials enhances cooling capacity,

to balance radiative cooling, latent heat, and heat transfer performances remains challenging due to their conflicting requirements. Inspired by the light scattering mechanism of nacre-pearl systems, hierarchically microstructured radiative-phase change hybrid cooling (RPHC) composites with a homogeneous morphology are developed via a water pre-removal strategy. The composite combines a multilayered microfibrillated cellulose (MFC) matrix with core-shell phase change capsules (PCCs), achieving solar reflectivity of 0.969 and mid-infrared emissivity of 0.958. Efficient PCC integration provides a high latent heat of 132.1 J g⁻¹. This nacre-pearl-inspired design enables a record-high PRHC power of 226 W m⁻² and an average temperature reduction of 10.1 °C below ambient. Applied to building envelopes, the MFC/PCC composite reduces cooling energy use by up to 4.4%, potentially cutting global CO₂ emissions by 1.22 billion metric tons annually. Overall, this work provides innovative energy-saving materials for energy savings and carbon neutrality. © 2025 Wiley - VCH GmbH.

Adv Sci (Weinh) (impact factor: 15.8) 1 

Cation- π Hydrogel Electrolyte for Flexible All-Solid-State Supercapacitors with Excellent Mechanical Deformation and Low-Temperature Tolerance.

Chenbei Wang, Minfei Dang, et al

Abstract:

Flexible supercapacitors are promising power sources for new-generation wearable electronics. However, their electrochemical performance often deteriorates under mechanical deformation and low-temperature environments. Here, a flexible supercapacitor is developed by sandwiching a hydrogel electrolyte between two electrodes. To address performance challenges, cation- π crosslinking sites are incorporated into the hydrogel network. These dynamic crosslinking sites act as efficient ion-hopping centers, imparting the hydrogel electrolyte with high fracture strength (1.8 MPa), strong ionic conductivity (3.9 S m⁻¹), and excellent anti-freezing properties. Furthermore, the hydrogel forms cation- π interactions with carbon nanotube-based composite electrodes, facilitated by the reaction between the indole groups and Na⁺ in the electrodes. This strong interfacial bonding minimizes electrode-electrolyte displacement during deformation, reducing interfacial resistance and enhancing charge transport efficiency. As a result, the cation- π hydrogel electrolyte enables the supercapacitor to achieve high energy storage, outstanding mechanical deformation tolerance, and robust performance at low temperatures. The device maintains 89.8% of its initial capacitance after 5000 bending cycles and retains 70.9% capacitance at -40 °C—significantly surpassing previously reported methods. This work presents an innovative strategy for designing high-performance hydrogel electrolytes for advanced energy storage systems. © 2025 The Author(s). Advanced Science published by Wiley - VCH GmbH.

Inverse vulcanization enabled self-motivated polysulfide silane: an ultra-efficient interfacial architecture for silica-filled elastomer hybrids.

Dong Wang, Yun Duan, et. al

Abstract:

Incorporating sulfur-containing silane coupling agents (SSCAs) into silica-filled rubber composites is essential to improve the compatibility between silica and the rubber matrix. However, the synthesis of SSCAs requires multi-step processes and organic solvent usage, and the silanization efficiency is rather low. Herein, we presented the facile synthesis of a self-motivated polysulfide silane (PSTG) via one-pot sequential inverse vulcanization of sulfur, methoxy polyethylene glycol acrylate and triethoxyvinylsilane and utilized it as a new-brand interfacial modifier for rubber composites. The polyethylene glycol chains in PSTG direct its ethoxysilyl groups onto the silica surface via hydrogen bonds and subsequently promote the silanization reaction, and the polysulfide fragments couple with rubber chains during vulcanization. The interactions of PSTG with silica and hierarchical structures of the composites were comprehensively studied. The incorporation of PSTG greatly strengthens interfacial interactions and improves silica dispersion in rubber composites, resulting in remarkably high static mechanical properties and ultra-low hysteresis loss when compared to the most widely used SSCA bis[γ -(triethoxysilyl)propyl] tetrasulfide at the same ethoxysilyl group content.

AMORPHOUS MATERIALS

Engineering Amorphous/Crystalline Ni/NiO Electrocatalysts for Highly Efficient Hydrogen Peroxide Production.

Rong-Yue Wang, Jia-Peng Zhong, et. al

Abstract:

Enhanced O₂ adsorption and favorable oxygen-intermediate desorption are essential for efficient electrochemical hydrogen peroxide production (EHPP) via the two-electron oxygen reduction reaction (2e⁻ ORR). Here, we report an amorphous/crystalline Ni-NiO electrocatalyst synthesized via a partial reduction strategy. By engineering the amorphous/crystalline interfacial strain through varying the reduction time, the optimized Ni/NiO catalyst achieves a hydrogen peroxide selectivity of 91.78% with a Faradaic efficiency of 97.47%. It maintains a high H₂O₂ yield of 949.5 mM/g-cat h⁻¹ across three electrode systems, outperforming most Ni-

based benchmarks. Density functional theory calculations and in situ characterizations reveal that strain at unsaturated Ni sites promotes electron redistribution and Ni-O bond lengthening, thereby shifting the d-p band center difference to favor O₂ adsorption while weakening *OOH binding. The enhanced O₂ adsorption and accelerated *OOH desorption direct the ORR pathway toward the two-electron route for H₂O₂ generation. Furthermore, the in situ generated H₂O₂ effectively degrades organic pollutants, indicating its practical utility in water remediation. This work presents the strain engineering approach in amorphous/crystalline Ni/NiO heterostructures for high-performance EHPP and selective two-electron ORR.

J Nanobiotechnology (impact factor: 12.6) 1 

Amorphous layered double hydroxide-based nano-enzyme eye drops against dry eye disease by inhibiting mitochondrial damage and pyroptosis

Dandan Chu, Tingting Hu, et. al

Abstract:

Chronic inflammation serves as a prominent contributor to the progression of dry eye disease (DED). Reactive oxygen species (ROS) and the downstream NLRP3 inflammasome mediate pyroptosis, which induces the inflammatory response by releasing several inflammatory factors. Therefore, targeting pyroptosis represents a promising therapeutic strategy for controlling inflammation in DED. Herein, we report the amorphous layered double hydroxide (a-LDH)-based nano-enzyme eye drops (Needs) for DED. The a-LDH exhibits superior hydroxyl radicals ($\cdot\text{OH}$) and superoxide anions ($\cdot\text{O}_2^-$) scavenging capabilities, which are 1.77 times and 1.20 times that of the crystalline ZnCuAl-LDH, and 3.38 times and 1.43 times that of conventional CeO₂, respectively. The augmented performance stems from the synergistic effect of Cu⁺/Cu²⁺ redox couples facilitating electron shuttling for radical disproportionation and oxygen vacancies serving as both preferential adsorption sites and active catalytic domains for ROS breakdown. More importantly, the a-LDH efficiently scavenges excess ROS, inhibits NLRP3/Caspase-1/GSDMD signaling axis-mediated pyroptosis and N-GSDMD-induced mitochondrial damage. In vivo assays indicate that the Needs reduce the expression of pro-inflammatory cytokines, reverse corneal epithelial defects, restore goblet cell density, and tear secretion in mice DED model. Our findings provide valuable insights into the underlying mechanisms and potential therapeutic strategies of LDH-based nano-enzymes for DED.

Synthesis of Crystalline Metallated Bipyridine COFs from Amorphous Gels for Enhanced Gas Storage and Electrocatalysis.

Jiawei Kang, Yawei Zhang, et. al

Abstract:

Bipyridine-functionalized covalent organic frameworks (Bpy-COFs) possess attractive physicochemical properties that have garnered significant research interest. Subsequent metallization of these frameworks further enhances their potential for diverse applications. However, conventional synthetic routes for Bpy-COFs often suffer from limited crystallinity due to the twisted moiety. Additionally, post-synthetic metallated Bpy-COFs frequently compromise their porosity. To address these critical limitations, a facile and novel strategy is reported for the direct preparation of crystalline metallated Bpy-COFs from amorphous Bpy-covalent organic gels (COGs), employing metal ions in concert with carbon dioxide (CO₂) subcritical fluid as a dynamic modulator. The resulting COF aerogels exhibit high porosity and dispersed metal sites, contrasting sharply with materials derived from traditional methods, and demonstrate substantially enhanced performance in hydrogen storage and the oxygen evolution reaction. This breakthrough in establishing a bridge between amorphous COGs and crystalline COFs not only broadens the synthetic accessibility of functional porous materials but also opens new avenues for the rational design of advanced crystalline frameworks with tailored functionalities. © 2025 Wiley - VCH GmbH.

NANOMATERIALS

Near-Field Mapping and Modulation of Dark Exciton-Plasmon Hybrid States on Planar Open Cavity.

Jianqiao Zhao, Zhaoxuan Zhang, et. al

Abstract

The modulation of excitons via coupling with plasmon polaritons represents a crucial approach for controlling light-matter interactions in nanophotonics. However, nanoscale characterization and modulation of dark exciton-plasmon hybrid states remain largely unexplored. In this study, we demonstrate a near-field approach for probing and modulating dark exciton-plasmon hybrid states through planar plasmonic nanostructures at room temperature. The designed meta-structure from the hole array on Au films generates surface plasmon polariton (SPP) interference hotspots with precisely controlled out-of-plane electric fields, enabling direct access to dark exciton and coupled states in monolayer WSe₂. By integrating transmission-mode scanning

near-field optical microscopy with in situ photoluminescence spectroscopy, we achieve simultaneous spatial mapping and spectral characterization of dark exciton-SPP hybrid states. We further propose the "quantitative modulation via spacer thickness" theory and approach, which quantifies the system's ultimate coupling capability and enables precise control over both the coupling strength and relative luminescence intensity of dark excitons. Our stress-free planar open cavity design provides a simple yet versatile platform for scalable excitonic devices, such as on-chip lasers and valleytronic systems. The modulation approach enables the multichannel excitonic information processing, which sets the foundation for advanced photonic devices, including optical switches, computing elements, and hybrid integrated circuits.

Sci Adv (impact factor: 12.5) 1 [X](#)

Sustainable synthesis of amino-cellulose nanofibers for biomaterial platforms.

Xiaochao Shi, Jian Zhang, et. al

Abstract

The increasing demand for sustainable materials has driven interest in harnessing renewable resources to develop advanced biomaterials. Cellulose nanofibers, derived from abundant natural reserves, offer excellent mechanical strength and thermal stability but lack inherent biofunctionality. This study presents a method that is green, cost-effective, and scalable to synthesize amino-cellulose nanofibers (A-CNFs) by grafting carboxyl groups and thereon amino groups onto cellulose, followed by ultrasonic nanofibrillation, resulting in ultrafine, lengthy A-CNF with enhanced mechanical properties, biocompatibility, and antibacterial activity. Comparative analyses demonstrate that A-CNF scaffolds exhibit favorable biostability, pore connectivity, and mechanical integrity in tissue engineering applications. Biological assessments further indicate improved cell viability and reduced hemolysis, underscoring A-CNF's potential as robust, biocompatible, and sustainable material platforms for biomedical use.

Proc Natl Acad Sci U S A (impact factor: 9.1) 1 [X](#) [TOP](#)

Nanomaterial-induced mitochondrial biogenesis enhances intercellular mitochondrial transfer efficiency.

John Soukar, Kanwar Singh, et. al

Abstract

Intercellular mitochondrial transfer, the spontaneous exchange of mitochondria between cells, is a recently described phenomenon crucial for cellular repair, regeneration, and disease management. Enhancing this natural process holds promise

for developing novel therapies targeting diseases associated with mitochondrial dysfunction. Here, we introduce a nanomaterial-based approach employing molybdenum disulfide (MoS₂) nanoflowers with atomic-scale vacancies to stimulate mitochondrial biogenesis in cells to make them mitochondrial biofactories. Upon cellular uptake, these nanoflowers result in a two-fold increase in mitochondrial mass and enhancing mitochondrial transfer to recipient cells by several-fold. This enhanced efficiency of transfer significantly improves mitochondrial respiratory capacity and adenosine triphosphate production in recipient cells under physiological conditions. In cellular models of mitochondrial and cellular damage, MoS₂ enhanced mitochondrial transfer achieved remarkable restoration of cell function. This proof-of-concept study demonstrates that nanomaterial-boosted intercellular mitochondrial transfer can enhance cell survivability and function under diseased conditions, offering a promising strategy for treating mitochondrial dysfunction-related diseases.

BIOMATERIALS

Proc Natl Acad Sci U S A (impact factor: 9.1) 1 TOP

Squamous cell carcinoma antigen-1/SerpinB3 is an endogenous skin injury response element.

Jordan Yaron, Shubham Pallod, et. al

Abstract

The squamous cell carcinoma antigen SerpinB3 is a serum-circulating biomarker of epithelial cancers associated with high metastasis, treatment resistance, and poor prognosis. Despite its clinical significance, the endogenous role of SerpinB3 has remained undefined. Here, we identify SerpinB3 as a mediator of epithelial wound healing. Injury induces SerpinB3 expression in vitro and in vivo in the migrating epidermal tongue; overexpression of the protein promotes epithelial-to-mesenchymal transition-like changes. Recombinant Serpinb3a, the mouse ortholog, enhances re-epithelialization in vitro and accelerates wound closure and collagen remodeling in vivo. These findings reveal a physiological function for SerpinB3 in epithelial repair and suggest that its expression in cancer, chronic wounds, and inflammatory diseases may reflect reactivation of a conserved wound response program-positioning SerpinB3 as a compelling therapeutic target.

Long-Term Cardiac Electrical Imaging Enabled by Ultrahigh-Resolution Foldable Heart-Machine Interfaces.

Chen Hang, Yizhou Jiang, et. al

Abstract:

The advancement of electrophysiological mapping for cardiac arrhythmias relies critically on overcoming key interface challenges: long-term biocompatibility, spatial resolution limitations, and mechanical mismatch with dynamic cardiac tissue. To address these, we developed a rapid encapsulation method for liquid metal electrode arrays at the 10- μ m scale, enabling the fabrication of ultrahigh-density and flexible sensor arrays (~28570 sensors/cm²) within 30 min. It constructs a fully foldable, high-density heart-machine interface deployable via minimally invasive access (<3 mm folded diameter). The interface achieves high-resolution imaging (in rat, rabbit, and dog models) of microscale electrical heterogeneity (e.g., 0.2 mm² reentrant pattern in ventricular fibrillation) while maintaining long-term reliability (100% electrode functionality over 98 days). This technology holds promise for advancing diverse human-machine interfaces for other organs and tissues, enabling the integration of multiple organs and even the whole body for comprehensive health management.

Engineered Transition Metal Oxide (TMO)-Encapsulated Salmon Skin-Based Bioadhesive Hydrogel Promotes Repair, Immunoregulation, and Neovascularization in MRSA-Infected Wounds.

Hong-Ying Xia, Ying-Tong Ye, et. al

Abstract:

Despite success in promoting tissue regeneration, the abundant nutrients in the decellularized extracellular matrix (dECM) are easily prone to environmental bacteria in vitro. Additionally, these dECM-based materials suffer from weak mechanical strength and rapid biodegradation, significantly limiting their potential for wound healing applications. To overcome these aspects, an innovative biohydrogel platform based on transition metal oxides (TMOs)-encapsulated salmon fish skin-derived dECM (FdECM) was developed to promote subsequent antibacterial activity and wound healing. The decellularization-assisted FdECM was initially grafted with photoresponsive methacrylic anhydride (MA) groups through amidation and then encapsulated with silver (Ag) nanodots-decorated manganese dioxide (MnO₂) nanoflowers (ζ value of -20 mV and size of 300 nm) to form FdECM-MA-Ag-MnO₂ (shortly denoted as Fd-AM) composites. Meanwhile, the Fd-AM demonstrated excellent adhesion, biocompatibility, and improved mechanical properties. FdECM and Ag-MnO₂ nanoparticles work synergistically to effectively reduce oxidative stress in

cells and promote the formation of tube-like structures by endothelial cells. Both in vitro and in vivo studies showed that the degradation of biocompatible Fd-AM biohydrogel released Ag-MnO₂, improving the hypoxic environment via MnO₂ and significantly combating methicillin-resistant *Staphylococcus aureus* (MRSA) through silver nanodots. The Fd-AM biohydrogel promoted the effective transformation of macrophages into M2 type, as evidenced by increased IL-10, decreased IL-6, higher CD206 (an M2 macrophage marker), and lower iNOS (an M1 macrophage marker). Additionally, these composites enhanced collagen deposition, exhibited antioxidant properties, and increased CD31 content. Overall, the TMO-encapsulated Fd-AM biohydrogel successfully delivered both antibacterial and antioxidant effects, supporting tissue regeneration (angiogenesis) in MRSA-infected wounds.

II Concentration

PHYSICS

Wavefront shaping enables high-power multimode fiber amplifier with output focus

Stefan Rothe, Chun-Wei Chen, et al.

Abstract

High-power fiber lasers are powerful tools used in science, industry, and defense. A major roadblock for further power scaling of single-frequency fiber laser amplifiers is stimulated Brillouin scattering. Efforts have been made to mitigate this nonlinear process, but these were mostly limited to single-mode or few-mode fiber amplifiers, which have good beam quality. Here, we explored a highly multimode fiber amplifier in which stimulated Brillouin scattering was greatly suppressed due to a reduction of light intensity in a large fiber core and a broadening of the Brillouin scattering spectrum by multimode excitation. By applying a spatial wavefront shaping technique to the input light of a nonlinear amplifier, the output beam was focused to a diffraction-limited spot. Our multimode fiber amplifier can operate at high power with high efficiency and narrow linewidth, which ensures high coherence. Optical wavefront shaping enables coherent control of multimode laser amplification, with potential applications in coherent beam combining, large-scale interferometry and directed energy delivery.

Quantum-amplified global-phase spectroscopy on an optical clock transition

Zaporski, Leon, Liu, Qi, et al.

Abstract

Optical lattice clocks are at the forefront of precision metrology^{1,2,3,4,5,6}, operating near a standard quantum limit set by quantum noise^{4,7}. Harnessing quantum entanglement offers a promising route to surpass this limit^{8,9,10,11,12,13,14,15}; however, there are practical difficulties in terms of scalability and measurement resolution requirements^{16,17}. Here we adapt the holonomic quantum gate concept¹⁸ to develop a new Rabi-type ‘global-phase spectroscopy’ that uses the detuning-sensitive global Aharonov–Anandan phase¹⁹. With this approach, we can demonstrate quantum-amplified time-reversal spectroscopy on an optical clock transition that achieves directly measured 2.4(7) dB metrological gain and 4.0(8) dB improvement in laser noise sensitivity beyond the standard quantum limit. To this end, we introduce rotary echo to protect the dynamics from inhomogeneities in light–atom coupling and implement a laser-noise-cancelling

differential measurement through symmetric phase encoding in two nuclear spin states. Our technique is not limited by measurement resolution, scales easily because of the global nature of entangling interaction and exhibits high resilience to typical experimental imperfections. We expect it to be broadly applicable to next-generation atomic clocks and other quantum sensors approaching the fundamental quantum precision limits^{20,21,22}.

Low-overhead transversal fault tolerance for universal quantum computation

Zhou, Hengyun, Zhao, et al.

Abstract

Fast, reliable logical operations are essential for realizing useful quantum computers^{1,2,3}. By redundantly encoding logical qubits into many physical qubits and using syndrome measurements to detect and correct errors, we can achieve low logical error rates. However, for many practical quantum error correction codes such as the surface code, owing to syndrome measurement errors, standard constructions require multiple extraction rounds—of the order of the code distance d —for fault-tolerant computation, particularly considering fault-tolerant state preparation^{4,5,6,7,8,9,10,11,12}. Here we show that logical operations can be performed fault-tolerantly with only a constant number of extraction rounds for a broad class of quantum error correction codes, including the surface code with magic state inputs and feedforward, to achieve ‘transversal algorithmic fault tolerance’. Through the combination of transversal operations⁷ and new strategies for correlated decoding¹³, despite only having access to partial syndrome information, we prove that the deviation from the ideal logical measurement distribution can be made exponentially small in the distance, even if the instantaneous quantum state cannot be made close to a logical codeword because of measurement errors. We supplement this proof with circuit-level simulations in a range of relevant settings, demonstrating the fault tolerance and competitive performance of our approach. Our work sheds new light on the theory of quantum fault tolerance and has the potential to reduce the space–time cost of practical fault-tolerant quantum computation by over an order of magnitude.

MATERIALS

Photo-induced nonvolatile rewritable ferroaxial switching

Z. Zeng, M. Först, et al.

Abstract

Ultrafast switching of ferroic phases is an active research area with technological potential. Yet, some key challenges remain, ranging from limited speeds in ferromagnets to intrinsic volatility of switched domains owing to depolarizing fields in ferroelectrics. Unlike these ferroic systems, ferroaxial materials host bistable states that preserve spatial-inversion and time-reversal symmetry and are therefore immune to depolarizing fields but also difficult to manipulate with conventional methods. We demonstrate photo-induced switching of ferroaxial order by engineering an effective axial field composed of circularly driven terahertz phonon modes. A switched ferroaxial domain remains stable for many hours and can be reversed back with a second terahertz pulse of opposite helicity. The effects demonstrated in this work may lead to the development of a robust platform for ultrafast information storage.

Anion sublattice design enables superionic conductivity in crystalline oxyhalides

Feipeng Zhao, Shumin Zhang, et al.

Abstract

Solid-state batteries are attractive energy storage systems as a result of their inherent safety, but their development hinges on advanced solid-state electrolytes (SSEs). Most SSEs remain largely confined to single-anion systems (e.g., sulfides, oxides, halides, and polymers). Through mixed-anion design strategy, we develop crystalline $\text{Li}_3\text{Ta}_3\text{O}_4\text{Cl}_{10}$ (LTOC) and its derivatives with excellent ionic conductivities (up to 13.7 millisiemens per centimeter at 25°C) and electrochemical stability. The LTOC structure features mixed-anion spiral chains, consisting of corner-shared oxygen and terminal chlorine atoms, which induces continuous “tetrahedron-tetrahedron” Li-ion migration pathways with low energy barriers. Additionally, LTOC demonstrates holistic cathode compatibility, enabling solid-state batteries operation at 4.9 volts versus Li/Li⁺ and low temperature, down to -50°C. These findings describe a promising class of superionic conductors for high-performance solid-state batteries.

Isothermal solidification for high-entropy alloy synthesis

Zhang, Qiubo, Gallant, et al.

Abstract

Kinetically trapping the high-temperature states through rapid cooling solidification is widely used for the synthesis of high-entropy alloys (HEAs), especially those with intrinsically immiscible elemental combinations^{1,2,3,4}. However, strategies need to be developed to overcome the fundamental limitations of rapid cooling solidification in

controlling the crystallinity, structure and morphology of HEAs. Here we introduce an isothermal solidification strategy for the synthesis of HEAs by rapidly altering the metal alloy composition through liquid–liquid interface reactions at low temperatures, for example, from 25 °C to 80 °C. We use gallium (Ga)-based metal as the sacrificial reagent and mixing medium. By directing the reactions to the interfaces between the Ga-based liquid metal and an aqueous metal ion solution, the foreign metal ions can be reduced at the interfaces and incorporated into the liquid metal quickly. HEAs with various crystallinity (single crystal, mesocrystal, polycrystal and amorphous), morphology (zero, two and three dimensions) and compositions can be achieved through the isothermal solidification. Ga can be completely consumed, resulting in Ga-free HEAs. If desired, Ga can be one of the metal elements in the final products. In situ liquid phase transmission electron microscopy (TEM) studies and theoretical analysis show the isothermal solidification mechanisms. Our direct observations show the enhanced mixing of liquid metal elements and the solidification process with fluctuating nucleation dynamics. The isothermal solidification marks a powerful strategy for HEA synthesis through an unexplored pathway of kinetically trapping the high-entropy states.

CHEMISTRY

Visible light–driven stereodivergent allylation of cyclic hemiacetals with butene for polypropionate synthesis

Hiroyasu Nakao, Mirja Md Mahamudul Hassan, et. al

Abstract

Catalytically transforming abundant hydrocarbon feedstocks into structurally complex, high-value molecules is a pivotal yet challenging goal in organic synthesis. The key difficulty lies in the simultaneous activation of chemically inert feedstocks and precise stereochemical control. Here, we report a catalytic stereodivergent allylation of unprotected cyclic hemiacetal aldols with butene, enabling the programmable synthesis of polypropionates—privileged structural motifs prevalent in biologically active compounds, including pharmaceuticals. This visible light–driven, selective transformation exhibits broad functional group compatibility, furnishing 1,3-polyols with multiple contiguous stereocenters in high yield and stereochemical fidelity. Moreover, this method provides a concise and practical route to key natural product intermediates with minimal protection–deprotection sequences. This strategy has the potential to streamline polypropionate synthesis while reducing the time, cost, and environmental impact.

The total synthesis of (–)-spiroaspertrione A: A divinylcyclopropane rearrangement approach

Wenbo Huang, Lu Pan, et. al

Abstract

The rise of multidrug-resistant pathogens poses a major threat to global health, with methicillin-resistant *Staphylococcus aureus* (MRSA) among the most challenging. One promising approach to overcoming resistance is using small molecules that resensitize MRSA to existing drugs. Here, we report the enantioselective total synthesis of one such promising candidate, (–)-spiroaspertrione A, a complex meroterpenoid of the andiconin family. This natural product has long eluded synthesis because of its densely functionalized polycyclic backbone. Our route features a stereoselective Diels-Alder cycloaddition, followed by a key divinylcyclopropane rearrangement forming the spirobicyclo[3.2.2]nonane core, which proved to be reversible and was further investigated by density functional theory calculations. Strategic late-stage functionalization of the compact cage architecture enabled access to the natural product and provided evidence for a plausible biosynthetic relationship with (–)-aspermerodione.

Durable, pure water-fed, anion-exchange membrane electrolyzers through interphase engineering

Shujin Hou, Archana Sekar, et. al

Abstract

Anion-exchange membrane water electrolyzers (AEMWEs) promise scalable, low-cost hydrogen production but are limited by the electrochemical instability of their anode ionomers. We report interphase engineering using inorganic-containing molecular additives that coassemble with ionomer, enabling pure water-fed AEMWEs to operate with a degradation rate <0.5 millivolt per hour at 2.0 amperes per square centimeter and 70°C—a >20-fold durability improvement. Analysis of different additives and ionomers shows that the stabilization mechanism involves cross-links between metal oxo/hydroxo oligomers and ionomers. Under operation, the inorganic additive enriches, forming an interphase near the water-oxidation catalyst that passivates the anode ionomer against continuous degradation while maintaining mechanical integrity and hydroxide conductivity. This additive-based interphase-engineering strategy provides a path to durable AEMWEs that operate without supporting electrolytes and is adaptable across diverse catalysts and ionomers for electrochemical technologies.

BIOLOGY

MTAP deficiency confers resistance to cytosolic nucleic acid sensing and STING agonists

Jung-Mao Hsu, Chunxiao Liu, et al.

Abstract

Cytosolic nucleic acid-sensing pathways are potential targets for cancer immunotherapy. Although stimulator of interferon genes (STING) agonists have shown substantial antitumor effects in animal models, their clinical efficacy in human tumors remains unclear. Deletion of methylthioadenosine phosphorylase (MTAP) is a common genomic alteration in human tumors but is rare in preclinical syngeneic mouse models. We found that homozygous MTAP deletion in human tumors creates a tumor microenvironment that obstructs cytosolic nucleic acid-sensing pathways by down-regulating interferon regulatory factor 3 (IRF3), leading to resistance to STING agonists. Targeting polyamine biosynthesis reverses IRF3 down-regulation, restoring sensitivity to STING agonists in MTAP-deficient tumors. Our findings suggest that MTAP genetic status may inform patient responses to STING agonist therapy and offer an alternative strategy for boosting antitumor immune responses using STING agonists in MTAP-deleted tumors.

mRNA initiation and termination are spatially coordinated

Ezequiel Calvo-Roitberg, Christine L. Carroll, et. al

Abstract

Transcriptional initiation and termination decisions drive messenger RNA (mRNA) isoform diversity but the relationship between them remains poorly understood. By systematically profiling joint usage of transcription start and end sites, we observed that mRNA using upstream starts preferentially use upstream end sites and that the usage of downstream sites is similarly coupled. Our results suggest a positional initiation termination axis (PITA), in which usage of alternative terminal sites are coupled based on their genomic order. PITA is enriched in longer genes with distinct chromatin features. We find that mRNA 5' start choice directly influences 3' ends depending on RNA polymerase II trafficking speed. Our results indicate that spatial organization and transcriptional dynamics couple transcription initiation and mRNA 3' end decisions to define mRNA isoform expression.

A cGAS-mediated mechanism in naked mole-rats potentiates DNA repair and delays aging

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Abstract

Efficient DNA repair might make possible the longevity of naked mole-rats. However, whether they have distinctive mechanisms to optimize functions of DNA repair suppressors is unclear. We find that naked mole-rat cyclic guanosine monophosphate–adenosine monophosphate synthase (cGAS) lacks the suppressive function of human or mouse homologs in homologous recombination repair through the alteration of four amino acids during evolution. The changes enable cGAS to retain chromatin longer upon DNA damage by weakening TRIM41-mediated ubiquitination and interaction with the segregase P97. Prolonged chromatin binding of cGAS enhanced the interaction between repair factors FANCI and RAD50 to facilitate RAD50 recruitment to damage sites, thereby potentiating homologous recombination repair. Moreover, the four amino acids mediate the function of cGAS in antagonizing cellular and tissue aging and extending life span. Manipulating cGAS might therefore constitute a mechanism for life-span extension.

III Calling for papers

MATDES 2026 (EI)

Submission deadline: Nov 1, 2025
Conference date: Mar 16, 2026 - Mar 18, 2026
Full name: International workshop on Materials and Design
Location: Barcelona, Spain

Today's products and their constituent components and structures have to meet increasingly stringent requirements during operation. The economic and human costs of failure during service impose a great deal of responsibility on organisations and individuals who select and integrate materials in a final engineering design. A critical feature of successful product development is the judicious selection of the best materials based on informed awareness of the capabilities and opportunities afforded by all candidates, coupled with a design that takes full advantage of their properties. A further aim of MatDes is to promote a greater knowledge and understanding of the attributes and capabilities of all types of modern engineering materials in the context of engineering design.

Call for papers:

The topics of interest for submission include, but are not limited to:

1. Micro- and nano-scale multi-physics phenomena, and the analysis structure, morphology, and the role of interfaces in relation to design at all scales, e.g. electrochemical energy storage, phase transformation and associated processes
2. Operando and in situ studies of processes and structural evolution
3. Processing of alloys and compounds for microstructure and property control, e.g. friction stir and severe plastic deformation
4. Lightweight materials, e.g. alloys containing magnesium and lithium, as well as composites of all types of matrix (polymer, metal and ceramic) and reinforcement, including continuous and discontinuous fibres, low aspect ratio inclusions and nano-structured reinforcements
5. Multifunctional materials, e.g. alloys, polymers and ceramics displaying shape memory effects, as well as bio-composites, composites of green or sustainable origin, and biomimetic materials
6. Intelligent materials design to optimise performance, including hierarchical microstructural optimisation, self-healing, energy absorption, for durability, against damage and environmental extremes • Health data privacy protection
 - Electronic Health Records
 - Multi-source data integration
 - Mental health assessment
 - Decision support system

ICAMIM 2025 (EI/SCOPUS)

Submission deadline: Nov 1, 2025
Conference date: Nov 14, 2025 - Nov 16, 2025
Full name: International Conference on Advanced Materials and Intelligent Manufacturing
Location: Guangzhou, China

The aim of the 2025 6th International Conference on Advanced Materials and Intelligent Manufacturing, which is to be held in Guangzhou, China, from November 14-16, 2025, is to share the latest research progress, especially on steel in the structural part of modern cars, and to strengthen the exchange of advanced materials and intelligent manufacturing technologies in various countries around the world. This conference will provide high-level technical exchange platforms to jointly promote continuous innovation in the field of advanced materials and intelligent manufacturing for worldwide experts, scholars, science and technology workers, entrepreneurs, and other relevant personnel engaging in advanced materials and intelligent manufacturing research.

We are warmly welcoming experts, scholars, and scientific and technological workers in this area to participate in this international academic exchange activity in the field of advanced materials and intelligent manufacturing technology.

Topics of Interest :

The topics of interest for submission include, but are not limited to:

● Advanced materials

- 01) Non-ferrous metal materials
- 02) Steel polymer material
- 03) Composites
- 04) Micro/nano materials
- 05) Optical/electronic/magnetic materials
- 06) New feature materials

● Intelligent manufacturing

- 01) Biomimicry mechanisms
- 02) Integrated manufacturing systems
- 03) Industrial and manufacturing systems analysis and decision-making
- 04) Digital manufacturing
- 05) Modeling and design
- 06) Intelligent systems
- 07) Intelligent mechatronics
- 08) Micromachining technology
- 09) Advanced manufacturing technology

ICMFM 2026 (EI)

Submission deadline: Nov 5, 2025
Conference date: Feb 28, 2026 - Mar 2, 2026
Full name: International Conference on Materials Engineering and Functional Materials
Location: Nha Trang, Vietnam

With ICMFM being successfully held in Hanoi, Da Nang, Hue in 2017, 2018 and 2019, and put on held from 2020 to 2024 due to the impact of COVID-19. 2025 ICMFM was held in Vietnam in the city of Da Nang during February 21-23, 2025. Now 2026 5th International Conference on Materials Engineering and Functional Materials will be held once again in Vietnam in the city of Nha Trang during February 28-March 2, 2026. The conference provides an international forum for researchers and practitioners to report most recent innovations and developments, summarize state-of-the-art, and exchange ideas and advances in all aspects of material engineering and functional materials.

Call for Papers:

- Materials Science and Engineering
Metallic Alloys, Tool Materials, Superplastic Materials, Ceramics and Glasses, Composites, Amorphous Materials, Nanomaterials, Biomaterials, Multifunctional Materials, Smart Materials, Engineering Polymers, Functional materials, Nuclear fuel materials.....
- Materials Properties, Measuring Methods and Applications
Ductility, Crack Resistance, Fatigue, Creep-resistance, Fracture Mechanics, Mechanical Properties, Electrical Properties, and Magnetic Properties, Corrosion, Erosion, Wear Resistance, Non-Destructive Testin.....
- Methodology of Research and Analysis and Modelling
Electron Microscopy, X-ray Phase Analysis, Metallography, Quantitative Metallography, Image Analysis, Computer Assistance in the Engineering Tasks and Scientific Research, Numerical Techniques, Statistic Methods, Residual Life Analysis, Process Systems Design, Mould Flow Analysis, Rapid Prototyping.....
- Materials Manufacturing and Processing
Casting, Powder Metallurgy, Welding, Sintering, Heat Treatment, Thermo-Chemical Treatment, Thin & Thick Coatings, Surface Treatment, Machining, Plastic Forming, Quality Assessment, Automation Engineering Processes, Robotics, Mechatronics, Technological Devices and Equipment, Theoretical Fundamentals of Cleaner Production, Industrial Application of Cleaner Production Methods, Production and Operations Management,.....
- Nanotechnology and smart materials
Nanomaterial synthesis, characterization and metrology, Nanotechnology integration, Micro/Nano materials, Smart and intelligent materials, Intelligent materials systems, Polymeric materials.....

CMAME 2025 (EI)

Submission deadline: Nov 5, 2025
Conference date: Dec 19, 2025 - Dec 21, 2025
Full name: International Conference on Mechanical, Automotive and Materials Engineering
Location: City University of Hong Kong, Hong Kong

2025 the 12th International Conference on Mechanical, Automotive and Materials Engineering (CMAME 2025) will be held at City University of Hong Kong, Hong Kong during December 19-21, 2025. The aim as well as objective of CMAME is to present the latest research and results of scientists working in the field related to Mechanical, Automotive and Materials Engineering topics. This conference provides opportunities for the delegates to exchange new ideas and application through face-to-face discussions, to establish business or research relations and to find global partners for future collaborations.

CMAME 2025 is organized by Royal Melbourne Institute of Technology, Australia and South Asia Institute of Science and Engineering(SAISE). CMAME 2025 is expected to be more exciting, stimulating & educative. The intention is to establish an effective platform for institutions and industries to share ideas and to present the works of scientists, engineers, educators and students across the globe. The organizing committee of symposium is pleased to invite prospective authors to submit their original manuscripts for possible presentation at CMAME 2025.

*Call for papers:

-Aerodynamics	-Fuels and Combustion	-Micro- and Nano Manufacturing
-Aerospace Systems and Technology	-Green Manufacturing	-Micro and Nanomaterials
-Alternative energy	-Heat and Mass Transfer	-Modeling of Processes
-Applied Mechanics and Design	-Solid and Fracture Mechanics	-Nano-Technology
-Composite Materials	-Heat Transfer	-Noise and Vibration analysis
-Computational Fluid Dynamics	-Industrial Engineering	-Optimization of Systems
-Design and Manufacturing	-Instrumentation and Control	-Refrigeration and air conditioning
-Energy conversion system	-Internal Combustion Engines	-Renewable and Non-Renewable Energies
-Energy Management	-Machine Design and Manufacturing	
-Fluid Dynamics	-Machinery Dynamics	

ICMMT 2026(SPRINGER)

Submission deadline: Nov 20, 2025
Conference date: Mar 26, 2026 - Mar 29, 2026
Full name: International Conference on Materials and Manufacturing Technologies
Location: Tokyo, Japan

2026 17th International Conference on Materials and Manufacturing Technologies (ICMMT 2026) is a premier, annual forum for researchers and scholars from multiple disciplines to come together to share knowledge, discuss ideas, exchange information, and learn about cutting-edge research in diverse fields with the common theme of Materials and Manufacturing Technologies. It is the 16th event in the series of successful scientific meetings that begun in 2010 in Chongqing (China). This first event was followed by the subsequent meetings organized in Xiamen, China (2011), Chengdu, China (2012), Seoul, Korea (2013), Kuala Lumpur, Malaysia (2014), Bali, Indonesia (2015), Chiang Mai, Thailand (2016), Singapore (2017), and in Moscow, Russia (2018), Kuala Lumpur, Malaysia (2019), Bangkok, Thailand (Full Virtual Style in 2020), Full Virtual Style in 2021 & 2022, Ho Chi Minh City, Vietnam(2023), Nha Trang, Vietnam(2024) and Sendai, Japan(2025).

Topics of interest

Topics of interest for submission include, but are not limited to:

Additive Manufacturing	MEMS/NEMS
Metal Joining	Chemical Materials
Subtractive Manufacturing	Optical/Electronic Materials
Sustainable Manufacturing Technologies	Magnetic Materials
Vibration Engineering	Cryogenic Materials
Mechanical Dynamics and Vibration	Micro/Nano Machining
Mechanical Strength	Metal Forming
Mechanical Design	Green Manufacturing
Casting Technology and Equipment	Non-Conventional Machining Processes
Plastic Processing Technology	
Cellular Manufacturing	
Advanced Manufacturing Processes	
Bio Materials	
Building Materials	
Ceramics, Shape Memory Alloys and Nanomaterials	
Materials for Aerospace Applications	
Polymers and Polymer Composites	
Glasses and Amorphous Systems	
Characterization and Testing	