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/2026/0409/c5474a210612/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 in researches on Materials. The papers are classified in 5 categories, and they are: **Nanomaterials, Polymers, Material Forming Process, Materials Design** and **Electronic Materials**. 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.

NANOMATERIALS

Angew Chem Int Ed Engl (impact factor: 16.9) 1 区 TOP

Biomimetic Supramolecular Assemblies With Programmable Structural and Chiroptical Dynamics.

Qian Wang, Jintao Zhang, et. al

Abstract:

The kinetic-thermodynamic synergy in protein folding has inspired out-of-equilibrium nanostructures; however, precise control and real-time visualization of their time-dependent structural evolution remain inaccessible, leaving the formation mechanisms of the final structure fundamentally constrained. Herein, a biomimetic non-equilibrium supramolecular assembly was developed, capable of spontaneous

transformation from a metastable state to a thermodynamically stable state via a mechanism analogous to amyloidogenesis. This morphological evolution was accompanied by a fluorescence shift from yellow (580 nm) to green (520 nm), which enabled real-time visual monitoring, along with an amplification of the glum value to 5.0×10- 3. The kinetics of transformation can be modulated by chirality, temperature, stirring, and seeding. Notably, a hydrogel matrix mimicking crowded intracellular environments was employed to investigate the assembly evolution, revealing accelerated transformation kinetics. The resulting fluorescence-tunable hydrogel was further exploited for time-dependent information encryption. This work offering new avenues for designing dynamic biomimetic materials with programmable chiroptical functions.© 2026 Wiley‐VCH GmbH.

ACS Nano (impact factor: 16) 1 区 TOP

Actively Induced Supercoiling Can Slow Down Plasmid Solutions by Trapping the Threading Entanglements.

Roman Staňo, Renáta Rusková, et. al

Abstract:

Harnessing the topology of ring polymers as a design motif in functional nanomaterials is becoming a promising direction in the field of soft matter. For example, the ring topology of DNA plasmids prevents the relaxation of excess twist introduced to the polymer, instead yielding helical supercoiled structures. In equilibrium semidilute solutions, tightly supercoiled rings relax faster than their torsionally relaxed counterparts, since the looser conformations of the latter allow for rings to thread through each other and entrain through entanglements. Here we use molecular simulations to explore a nonequilibrium scenario, in which a supercoiling agent, akin to gyrase enzymes, rapidly induces supercoiling in the suspensions of relaxed plasmids. The activity of the agent not only alters the conformational topology from open to branched, but also locks in threaded rings into supramolecular clusters, which relax very slowly. Ultimately, our work shows how the polymer topology under nonequilibrium conditions can be leveraged to tune dynamic behavior of macromolecular systems, suggesting a method to create a class of driven materials vitrified by activity.

J Am Chem Soc (impact factor: 15.6) 1 区 TOP

Ligand-Orchestrated Burst Nucleation Enables Ultrasmall Phase-Pure High-Entropy Nanoalloys with Active-Armor Interfaces.

Rui Ma, Chongyuan Zhai, Ru-Yu Zhou, et. al

Abstract:

High-entropy alloy (HEA) nanocatalysts offer exceptional compositional flexibility for electrocatalysis, yet their nanoscale synthesis is constrained by a thermodynamic-kinetic conflict: high temperatures required for entropic stabilization promote sintering, while asynchronous reduction of multicomponent precursors induces premature phase segregation. Here, we demonstrate a ligand-mediated strategy that addresses this conflict by employing 1,10-phenanthroline to coordinate disparate metal precursors. This interaction significantly retards the reduction onset, shifting nucleation into a narrow, high-temperature window where rapid atomic diffusion enables fast alloying. Simultaneously, the ligand's in situ carbonization generates an atomically thin, chemically bonded N-doped carbon layer that kinetically confines nanoparticle growth and stabilizes the single-phase solid-solution phase against surface-energy-driven sintering. Distinct from physical barriers that passively isolate, the chemically coupled HEA-carbon interface functions as an active armor that enhances catalytic functionality by electronically modulating the HEA core and reshaping the local reaction microenvironment through regulated interfacial solvent organization and reactant accessibility. As a result, phase-pure ~2.7 nm PtRuCuCoNi nanoparticles exhibit high oxygen reduction activity and durability, delivering a peak power density of 1.92 W cm-2 and maintaining stable operation for 100 h at a high current density of 1 A cm-2 in an anion-exchange membrane fuel cell. This work illustrates how integrating reduction retardation with chemically active encapsulation can transform stability constraints into functional advantages, offering a general strategy for resilient multicomponent nanomaterials.

POLYMERS

Water Res (impact factor: 12.4) 1 区 TOP

Polymer-dependent accumulation of PFASs on microplastics in Xiamen Bay: field evidence and laboratory partitioning.

Haitao Lin, Weiming Kuang, et. al

Abstract:

Per- and polyfluoroalkyl substances (PFASs) are widespread in coastal waters, yet evidence for PFASs carried by microplastics (MPs) remains limited in semi enclosed bays. A method was optimized to extract and quantify MP associated PFASs and applied to Xiamen Bay. With MP standards spiked with 15 PFASs, 0.1% ammonia in methanol yielded recoveries of 76.83-109.15%. Field MPs contained eight PFASs (52.10 ± 15.79 ng g-1 of ΣPFAS) and were dominated by foamed polystyrene (PS, 78.73%) and PE/PP (21.27%). PFAS burdens were higher on PS, with PFOS contributing disproportionately. Paired surface waters contained 13 PFASs (mean: 80.19 ng L-1) dominated by short chain PFCAs (PFHxA and PFPeA). MPs-water partitioning indicated moderate enrichment (1.93-3.73 of log Kd-WM) and slightly stronger partitioning to PS, and correlation and multivariate patterns showed PS associated compositions tracked dissolved phase variability more closely than PE/PP. Batch sorption experiments with pristine and UV aged PS confirmed stronger PFOS than PFOA sorption and enhanced uptake after aging. Spatial patterns were consistent with stronger river influence on short chain acids and more localized coastal inputs for long chain sulfonates, suggesting that aged buoyant MPs can intensify MP associated PFAS co-contamination in semi-enclosed coastal waters.Copyright © 2026 Elsevier Ltd. All rights reserved.

Small (impact factor: 12.1) 2 区 TOP

Artificial Crystalline-Amorphous Architecture Enables Continuous Ion Transport in Poly(Vinylidene Fluoride)-Based Solid-State Electrolytes.

Yue-Ming Chen, Min Zuo, et al

Abstract:

Solid-state polymer electrolytes (SPEs) hold promises for next-generation batteries but are hindered by low ionic conductivities. This issue stems from crystalline regions that block long-range ion transport in amorphous phases, while fully amorphous polymers are mechanically unstable. Here we design an "artificial crystalline-amorphous" architecture that converts the isolated amorphous conduction zones into continuous, long-range pathways. This is achieved by infiltrating a fully amorphous poly (vinylidene fluoride-co-chlorotrifluoroethylene) (PVT) into an oriented electrospun fibrous framework of polar semi-crystalline PVT. The framework serves as an "artificial crystalline phase," offering robust mechanical support and facilitating lithium-salt dissociation. Simultaneously, the amorphous phase utilizes this microscale network to enable long-range ion conduction. The resulting SPEs exhibit an extremely high ionic conductivity of 1.23 mS cm-1 at 25°C, outperforming most reported all-polymeric-SPEs (10-7 ~ 10-5 S/cm). Li//Li symmetric cells demonstrate stable cycling over 1300 h at 0.2 mA cm-2, in clear contrast to 60 h for the controlled cell. Furthermore, assembled high-voltage Ni0.8Co0.1Mn0.1O2 (NCM811)//Li full cells also deliver a stable cycling performance at 25° C. This work opens a new route for improving ion transport efficiency by constructing an artificial crystalline-amorphous structure.© 2026 Wiley‐VCH GmbH.

IEEE Trans Biomed Eng (impact factor: 4.5) 2 区

A chip integration method for implantable devices based on structural embedding using cyclic olefin copolymer.

Taekyung Lee, Joowon Lee, Jisung Kim, et. al

Abstract:

Reliable chip integration remains a major challenge in implantable devices, where continuous fluid exposure, mechanical deformation, and severe space constraints must be addressed simultaneously. Existing chip packaging approaches often create structural dead space and require complex encapsulation, which can increase vulnerability to fluid ingress and long-term reliability degradation under implantation-relevant conditions. This study presents a chip integration strategy based on structural embedding using cyclic olefin copolymer (COC). Integrated circuit chips were embedded into a thermoplastic polymer substrate through an inverse truncated pyramid (ITP) geometry, enabling direct electrical integration without additional interconnection space. The integrated structure was subjected to a broad set of evaluations under implantation-relevant conditions, including in vitro biocompatibility assessment, electrical connectivity measurement, mechanical and thermal reliability testing, long-term insulation evaluation, and functional validation. The proposed approach achieved an electrical connectivity yield of up to 87% after PEDOT:PSS reinforcement. Finite element analysis showed that the ITP geometry redistributed mechanically induced stress away from the chip in terface and facilitated spatial dissipation of chip-generated heat. Long-term soak testing confirmed stable electrical insulation for 380 days, corresponding to aprojectedoperational lifetime of approximately 14.5 years under physiological conditions. Embedded functional devices also retained stable electrical performance after integration. These results demonstrate that the proposed structural embedding strategy enables monolithic, space efficient, and mechanically robust chip integration under implantation-relevant conditions. Taken together, the findings suggest that the proposed approach may offer a promising basis for further development toward compact and reliable implantable devices with integrated electronics.

MATERIALS DESIGN

Phys Rev Lett (impact factor: 9) 1 区 TOP

Altermagnetic Proximity Effect.

Ziye Zhu, Richang Huang, et. al

Abstract:

Proximity effects complement conventional materials design by enabling interfacial properties absent in any constituent. Here, we uncover an altermagnetic proximity effect (AMPE), distinct from ferromagnetic and antiferromagnetic proximity, in which the hallmark momentum-alternating spin splitting of an altermagnet is transferred across an interface into an adjacent nonmagnetic layer-a process we term "altermagnetization." Using first-principles calculations and model analysis, we identify the AMPE in heterostructures based on the prototypical van der Waals altermagnet V_{2}Se_{2}O, where a proximitized monolayer PbO acquires

altermagnetic band splitting and real-space spin textures, with systematic tunability via interlayer spacing and magnetic configuration. We further demonstrate that the AMPE enables valley-dependent spin splitting in the semiconductor PbS and realizes topological superconductivity in the s-wave superconductor NbSe_{2}, both inheriting the altermagnetic spin texture. Finally, we validate the generality and experimental feasibility of the AMPE by realizing it in a broader class of established altermagnets, including V_{2}Se_{2}O derivatives, Ruddlesden-Popper perovskites, and the metallic CrSb. Our results identify the AMPE as a universal proximity mechanism and a versatile platform for engineering emergent quantum phenomena in heterostructures.

Phys Rev Lett (impact factor: 9) 1 区 TOP

Experimental Observation of Anomalous Stopping of Mega-ampere Electron Current in Porous Materials.

K Jiang, Z Deng, T Huang, et. al

Abstract:

Energy loss of fast electrons in materials is a fundamental process in many fields spanning fusion research, high-energy-density physics, astrophysics, and material science. Contrary to conventional collisional theory that predicts greater energy loss in denser materials, we experimentally observe an anomalous phenomenon: high-current-density electron beams undergo significantly stronger deflection and stopping in low-average-density porous foams than in their denser counterparts. Pore-resolved simulations and theoretical analysis demonstrate that return currents along the foam's skeleton generate multi-kilo-Tesla magnetic fields in the vacuum pores. These intense fields strongly scatter beam electrons, enhancing stopping by orders of magnitude beyond collisional predictions. The derived conditions for this anomalous stopping agree with experiments and simulations, establishing a new microstructure-mediated regime of beam-matter interaction with potential applications in charged-beam control for fusion and laboratory astrophysics.

J Phys Chem Lett (impact factor: 4.6) 2 区 TOP

Cost-Effective Digital Discovery of Aza-Hydrocarbons via Isomerization for Inverted Singlet-Triplet Emitters.

Ramalingam Mahaan, Zhigang Shuai, et. al

Abstract:

Hund's rule, derived from direct exchange (K), dictates that triplet (T1) lies below singlet (S1), leading to the 25% limit for electrofluorescence. Kinetic exchange (-t2/U) from charge-transfer perturbation can stabilize S1 over T1, enabling inverted singlet-triplet (IST) gaps and offering a promising route to triplet harvesting. Such materials

are exceedingly rare, and systematic design remains elusive. Here, we employ newly developed target-state optimized density functional theory (TSO-DFT) for cost-effective excited-state calculations, yielding reliable IST signatures with the B3LYP functional. Subsequently, we apply a high-throughput virtual screening (HTVS) to explore nitrogen-doped hydrocarbons derived from C10H8, C14H10, C16H10, C18H12, and C20H12 molecular cores via isomerization. This workflow screens 118 081 viable structures down to 34 potential candidates exhibiting negative S1-T1 gaps, an appreciable oscillator strength of ⩾0.01, and fast RISC rates (~108 s-1). This study provides a discovery pipeline for novel IST emitters and a curated library of visible-light candidates for next-generation optoelectronics.

MATERIAL FORMING PROCESS

Small (impact factor: 12.1) 2 区 TOP

Coupling Dead-Lithium Reactivation and Interfacial Stabilization for Long-Life Lithium Metal Batteries.

Qiuxue Jian, Yanchao Fan, et. al

Abstract

Lithium metal batteries (LMBs) experience poor cycling stability mainly due to the interfacial instability of the lithium metal anode and the unavoidable accumulation of electrochemically inactive dead lithium. Here, we report a multifunctional Li3Bi&LiI composite artificial anode interphase that forms in situ via a simple one-step interfacial reaction between BiI3 and lithium metal. This architecture combines the functions of Li3Bi for interfacial coupling and mechanical strength with LiI to improve Li+ transport, extend the Sand's time, and ensure uniform lithium deposition. More importantly, partially dissolved LiI enables a reversible I-/I3 - redox process that continuously reactivates dead lithium into cyclable Li+, directly addressing lithium inventory loss. Benefiting from the synergistic coupling of interfacial stabilization and lithium recycling, the optimized lithium anode achieves ultra-long dendrite-free cycling exceeding 10 000 h and maintains stable operation >450 h even at an ultrahigh current density of 10 mA cm-2. When paired with a LiFePO4 cathode, the LMB retains a 94.4% capacity retention after 500 cycles. This work integrates interfacial stabilization with active lithium recycling in a single protective design, offering a viable strategy toward long-life LMBs.© 2026 Wiley‐VCH GmbH.

ACS Appl Mater Interfaces (impact factor: 8.2) 2 区 TOP

Sodium-Selective Channels Enabled by De Novo Encapsulated

Azamacrocycles for Boosting Osmotic Energy Harvesting.

Chun-Kui Hu, Yan-Hong Liu, et. al

Abstract

Similar to the selective filter of biological ion channels, crown ethers have numerous dipole moments arranged around its interior, forming spatially confined electronegativity capable of attracting target ions while rejecting other species. In this light, crown-ether-based membranes have the potential to render both benign ion selectivity and high throughput and therefore enable highly efficient osmotic energy harvesting, however not yet implemented. Herein, we develop biomimetic sodium-selective channels via de novo encapsulation of diazacrown ethers into UiO-66 membranes. The embedding of such azamacrocycles exclusively enhances Na+ flux while blocking other cations, leading to the concurrent enhancement of Na+ selectivity and permeability. This can be ascribed to the interplay between ion dehydration and azamacrocycle-cation recognition, which resulted in a lower energy barrier for Na+ transport in contrast to other cations. The optimized permeability-selectivity combination enables the azamacrocycle-encapsulated membranes highly favorable in terms of osmotic energy harvesting, where an impressive output power density of 11.5 W m-2 is achieved by mixing natural seawater and river water. This work presents a methodology for developing high-performance ion-selective membranes with biomimetic channel structures, suitable for applications involving complicated separation processes and energy conversion systems.

ACS Appl Mater Interfaces (impact factor: 8.2) 2 区 TOP

Mechanically Adaptive Viscoelastic Grain-Boundary Regulation in Blade-Coated Tin-Lead Perovskites.

Zhuo Feng, Yixi Gu, Wenwen Zheng, et. al

Abstract

Nonequilibrium crystallization during scalable coating processes strongly influences the nanoscale structure of perovskite films, often inducing coupled mechanical stress and defect accumulation at grain boundaries. Controlling this stress-defect interplay remains a major challenge for achieving high-performance perovskite materials and their scalable integration. Here, we present a mechanically adaptive viscoelastic grain-boundary regulation strategy enabled by an in situ phase transition of polyacrylonitrile. Upon thermal activation, the polymer forms a transient viscoelastic state within the crystallization window, acting as a deformable intergranular medium. This viscoelastic phase accommodates crystallization-induced stress through elastic deformation and viscous flow, while interacting with grain-boundary regions to tune local interfacial configurations. As a result, the perovskite films exhibit reduced residual stress, suppressed defect density, and enhanced structural coherence. Blade-coated tin-lead perovskite solar cells achieve a power conversion efficiency of 21.02%, and monolithic two-terminal all-perovskite tandem devices reach 26.94%. These results demonstrate an effective strategy for grain-boundary regulation, offering a practical pathway toward scalable, high-performance perovskite tandem photovoltaics.

ELECTRONIC MATERIALS

J Am Chem Soc (impact factor: 15.6) 1 区 TOP

Ultrahigh Te-Content Low-Pressure All-Solid-State Li-Te Batteries.

Junwu Sang, Borui Liu, et. al

Abstract

Tellurium (Te), with high volumetric capacity (2621 mAh cm-3) and decent electronic conductivity (2000 mS cm-1), has emerged as a promising cathode material for future lithium metal batteries. However, all-solid-state batteries (ASSBs) with Li-Te chemistry remain largely unexplored. Here, we construct a nanostructured Te91@LPSC-350 composite in which ~10 nm Te domains are uniformly embedded within an amorphous Li5.5PS4.5Cl1.5 (LPSC) matrix, featuring an ultrahigh Te content of 91 wt % and intimate solid-solid contact. This nanocomposite exhibits high electronic conductivity (121 mS cm-1) and appreciable ionic conductivity (0.1 mS cm-1, after lithiation), enabling ultrafast and highly reversible Te redox reactions in the solid-state. Resultantly, ASSBs with the Te91@LPSC-350 nanocomposite cathode deliver their theoretical capacity of 420 mAh g-1 at 0.25 mA cm-2, maintain ultralong cycling stability over 13,000 cycles at 12.5 mA cm-2, and achieve a high areal capacity of 21 mAh cm-2. Furthermore, all-solid-state Li-Te pouch cells with an energy density of 1100 Wh L-1 (based on Li and Te91@LPSC-350) retain 81% of their initial capacity after 200 cycles under 2.5 MPa. Notably, Te can be directly recovered by exploiting its 100% selectivity in a vaporization-condensation process. These results demonstrate that all-solid-state Li-Te batteries are a safe, energy-dense, and sustainable energy storage technology.

Sci Adv (impact factor: 12.5) 1 区

Bioinspired ionic thermoreceptors with anisotropic architecture for thermotactile perception in robots.

Xuan Cai, Yilin Zeng, Pei Liu, et. al

Abstract:

Emulating human skin's ability to perceive temperature and identify material through thermotactile perception is critical for human-machine interaction, robotics operation, and prosthetic sensory feedback systems. However, conventional artificial thermal sensors are largely limited to temperature measurement and cannot replicate the thermotactile-mediated material recognition capabilities inherent in biological systems. Here, we present a bioinspired ionic thermoreceptor with anisotropic thermal response characteristics, enabling high-fidelity material recognition and accurate temperature monitoring. The device incorporates spatially specialized sensing elements that encode thermal signals into modality-specific temporal response patterns, allowing the extraction of the thermal contact coefficient for material discrimination and the absolute temperature for precise thermal monitoring. It achieves high-accuracy material recognition (98.9%) and substantial temperature resolution (0.81 millikelvins). Furthermore, robust covalent bonding between functional layers ensures mechanical durability, signal stability, and environmental resilience. This work establishes a physically grounded and energy-autonomous thermotactile sensing platform for safe, intuitive, and intelligent human-machine interaction.

Sci Adv (impact factor: 12.5) 1 区

Long-cycling organic flow batteries enabled by electronic-spatial synergistic modulation.

Tao Wang, Yuheng Xia, Chenlong Gao, et. al

Abstract:

Aqueous organic redox flow batteries (AORFBs) show promise for grid-scale energy storage but are limited by inadequate stability and solubility of active materials. Here we report an electronic-spatial synergistic modulation strategy to simultaneously enhance aqueous dissolution and electrochemical robustness of organic species, demonstrated on 4-aminophenol (PAP)-based molecules. By introducing a piperazine ring and an acetyl group at the amino site, we design 1-(4-(4-hydroxyphenyl)piperazin-1-yl)ethan-1-one (AHPP). This synergistic modulation stabilizes the oxidized state, suppresses side reactions, and boosts solubility to 1.9 molar in aqueous solution (3.8-molar electron concentration). An all-organic flow battery based on AHPP achieves 95.7% capacity retention after 5000 cycles, with stable operation across a wide temperature range. Integrating in situ spectroscopic and electrochemical analysis with computational modeling elucidates the redox chemistry of PAP-based molecules and establishes a link between intermediate stability and functional group effects. Life cycle assessment further reveals the environmental footprint of AHPP-based batteries, demonstrating considerable potential for practical grid-scale storage applications.

Ⅱ Concentration

PHYSICS

Gaussian boson sampling with 1,024 squeezed states in 8,176 modes

Liu, Hua-Liang, et al.

Abstract

The development of large-scale, high-fidelity quantum processors is a fundamental scientific challenge, essential for exploring the boundaries of classical computation and advancing towards fault-tolerant systems. Gaussian boson sampling not only serves as a prominent model for demonstrating quantum computational advantage[1,2,3] but can also generate bosonic error-correcting codes for fault-tolerant quantum computing[4,5,6]. However, its scalability has been hindered by significant photon loss in increasingly large and complex encoding circuits. Here we show a programmable photonic quantum processor, Jiuzhang 4.0, which incorporates 1,024 high-efficiency squeezed states into a hybrid spatial–temporal encoded 8,176-mode circuit. By achieving 92% source efficiency and 51% overall system efficiency, the processor produces samples with detection events up to 3,050 photons, representing an order-of-magnitude increase in scale over previous demonstrations[7,8,9,10]. This architecture realizes a cubic scaling of connectivity ($16^3 = 4,096$), enabling sampling within a Hilbert space of dimension approximately $10^{2,461}$. The experimental results are rigorously validated against all current classical simulation methods, especially the matrix product state algorithms recently designed to exploit photon loss[11]. The ability to control thousands of photons in programmable low-loss quantum processors pushes the experimental frontier into a regime far beyond classical tractability and opens a pathway to trillion-qumode three-dimensional cluster states and fault-tolerant photonic quantum hardware.

Electrocaloric effects across room temperature in multilayer capacitors

Guo, M., Farenkov, et al.

Abstract

A growing number of cooling devices[1,2,3,4] exploit large electrocaloric effects associated with a supercritically driven first-order ferroelectric phase transition in multilayer capacitors of $PbSc_{0.5}Ta_{0.5}O_3$ (PST)[5]. However, these multilayer capacitors only operate above the room-temperature Curie temperature and require an energetically expensive 42-day anneal for high B-site order to maximize latent heat. Here we show that exaggerating valence mismatch through dilution with

$PbMg_{0.5}W_{0.5}O_3$ (PMW) maintains high B-site order and latent heat with no anneal, while disrupting dipolar order to reduce the Curie temperature as low as 230 K. Our multilayer capacitors of PST–PMW show supercritical electrocaloric effects of about 3 K across and well below room temperature owing to 17.1 V μm^{-1} fields we apply >10^7 times without breakdown. Using our multilayer capacitors in an ideal fluid regenerator and assuming work recovery yields cycle efficiencies of 70–90%. Taken together, our findings imply that multilayer capacitors of PST–PMW should now replace multilayer capacitors of PST in electrocaloric prototypes to permit electrocaloric refrigeration.

Decoding the evolution of melodic and harmonic structure of Western music through the lens of network science

Di Marco, Niccolò, Loru, Edoardo, et al.

Abstract

Music has always been central to human culture, reflecting and shaping traditions, emotions, and societal changes. Therefore, analysing the quantitative properties of musical compositions can provide insights into specific aspects of human cultural evolution. In this study, we conduct a large-scale analysis of approximately 20,000 musical pieces rooted in Western musical practices. The resulting dataset encompasses MIDI transcriptions of works from six major macro-genres, spanning nearly four centuries of musical history. We model musical composition as weighted directed networks, enabling a systematic investigation of melodic and harmonic properties through a network-based representation of music. Our results show that different genres have distinct topological and musical properties, providing valuable insights into the origins of their differences. Moreover, a temporal analysis reveals systematic changes in network-based measures, suggesting a trend toward increasing similarity and reduced complexity in the melodic and harmonic structures. Notably, within this analytical perspective, even long-established and structurally complex genres such as Classical and Jazz display patterns that are increasingly comparable to those of more recent genres.

MATERIALS

Bypassing the yellow phase for extremely stable formamidinium lead iodide perovskite solar cells

Rabindranath Garai, Isaac Metcalf, et al.

Abstract

Using modeling and structural studies, we show that chloride incorporation in formamidinium lead iodide (FAPI) perovskites alters the energetics of both the formation and degradation pathways. We fabricated films with two coadditives [15 mole % FA chloride (FACl) and 0.5 mole % BA_2PbI_4, where BA is butylammonium)], in which FACl ensures chloride incorporation and both additives collectively create a compressive lattice strain that stabilizes the FAPI black phase and bypasses the formation of a yellow phase during degradation. The coadditive strategy revealed a favorable transition from face-sharing 2H, 4H, 6H, and 8H phases to the corner-sharing 3C black phase. Photovoltaic devices with a p-i-n architecture had an average power conversion efficiency (40 devices) of 24.1% and lost only 2% of their efficiency after 1200 hours at 85° ± 5°C, 1-sun illumination, and open-circuit conditions. Upon stressing at 15-sun illumination at 90°C for >400 hours, the stabilized black 3C phase degraded not through the 2H-PbI_2 phase but through the energetically uphill 3R-PbI_2 phase.

Narrow-bandgap acceptors with suppressed exciton thermalization loss for highly efficient perovskite–organic tandem solar cells

He, Haozhe, Jia, Zhenrong, et al.

Abstract

The development of high-performance perovskite–organic tandem solar cells has been impeded by the scarcity of efficient narrow-bandgap small-molecule acceptors. Realizing such materials requires overcoming the energy gap law to minimize the energy loss and simultaneously optimizing the donor–acceptor phase separation. Here, to address these challenges, we present an asymmetric halogen heavy-atom modification strategy, synthesizing a series of narrow-bandgap small-molecule acceptors, namely, E3-2Cl, E3-2Br and E3-2I. The heavy-atom effect restricts molecular backbone vibrations and suppresses reorganization energy, thereby enhancing the luminescence efficiency and reducing the non-radiative energy loss, which collectively contribute to a higher open-circuit voltage. In parallel, this approach strengthens terminal-mediated intermolecular interactions, leading to well-defined donor–acceptor double fibril morphology and improved phase separation in the blend films. As a result, the organic solar cells based on E3-2Cl deliver a remarkably low energy loss of 0.488 eV and a power conversion efficiency of 20.7%, ranking among the highest for low-energy-loss organic solar cells. Furthermore, by integrating the E3-2Cl-based organic rear sub-cell with a wide-bandgap perovskite front cell, we demonstrate a perovskite–organic tandem solar cell with an open-circuit voltage of 2.18 V and a power conversion efficiency of 28.2% (certified, 27.5%) under an aperture area exceeding 1 cm^2. This work establishes a viable molecular design strategy for developing low-energy-loss narrow-bandgap acceptors, paving the way for high-efficiency perovskite–organic tandem solar cells.

Low-temperature polyethylene terephthalate upcycling by phenolic ionic liquids

Ou, Xu, Zhang, Heming, et al.

Abstract

Upcycling end-of-life polyethylene terephthalate (PET) to valuable chemicals is crucial for achieving circular economy. However, in practice it faces many challenges, such as harsh operation conditions and the generation of lower-quality products needing down-processing. Here we develop a phenolic ionic liquids-mediated process that is capable of complete PET conversion into valuable monomers at 70 °C in the presence of various nucleophiles. This is achieved primarily owing to the strong π–π interactions between the phenolic anion and benzene rings on the PET main chains and the interactions between the phenolic anion and nucleophiles. The depolymerization of 100 g mixed real-life PET waste plastics was achieved with a high dimethyl terephthalate yield of 93.1%. In addition, the obtained PET ammonolysis monomers can be further copolymerized with carbon dioxide (CO_2) to synthesize polyurea, thereby eliminating the requirement for further separation and purification processes. Overall, this work not only offers insights into plastic upcycling process design but also presents a viable strategy for co-upcycling PET and CO_2 into valuable materials, paving the way to sustainable plastic waste management and circular economy.

CHEMISTRY

A molecular pathway to corrosion-resistant printable copper

Jun Zhang, Qiubo Zhang, Qikun Feng, et. al

Abstract

Copper's exceptional electrical and thermal conductivities make it essential for electronics and energy systems. However, oxidation and corrosion limit its long-term reliability, and existing protection strategies often involve high-temperature or multistep processing. We report a molecularly reactive strategy that converts copper precursors to metallic copper at <150°C, while generating an ultrathin carbonaceous and copper(I) surface passivation. Catechol-based ligands mediate copper reduction, enable low-temperature interparticle fusion, and impart surface passivation, yielding flexible copper with low resistivity and exceptional stability (>1000 hours in acid, >200 hours in sulfide, >240 hours at 140°C). This strategy resolves the long-standing trade-off between conductivity, corrosion resistance, and processability for next-generation flexible electronics and energy systems.

Alkali-ion-modified zeolitic imidazolate framework glasses

Kolodzeiski, Pascal, Gallant, Benjamin M., et. al

Abstract

Modifying glass compositions is key to creating silicate-based glasses for technologies including optical fibres, catalytic supports, protective coatings and separation membranes. Here we extend this concept to metal–organic framework (MOF) glasses by modifying the MOF glass former ZIF-62 with Li(bim) and Na(bim) as compatible glass modifiers (benzimidazolate, bim^-). Melt-quenching of physical mixtures with increasing Na(bim) content yields modified MOF glasses that exhibit a systematic decrease in the glass transition temperature (T_g), accompanied by increased liquid fragility, configurational heat capacity at T_g and density: paralleling silicate glass chemistry through partial network depolymerization. Structural and spectroscopic analysis, coupled with density-functional theory calculations, confirm that Na(bim) is incorporated homogeneously into the MOF glass framework rather than the pores and reveal the presence of undercoordinated sodium ion environments. Finally, extraction of the modifier by water treatment increases glass porosity, akin to established borosilicate glass processes. This work introduces a transferable approach for tailoring the structure and properties of MOF glasses.

Decarboxylative alkylation of alkenes

Roy, Triptesh Kumar, Tamborini, et. al

Abstract

Alkenes are widely used functional groups in synthetic chemistry, important for producing polymers, detergents, agrochemicals and pharmaceuticals. When treated with electrophiles, alkenes typically undergo addition, not substitution, reactions1. As a consequence, the intuitive retrosynthetic disconnection to form a substituted alkene from the parent alkene does not exist in the toolbox of the chemist. For example, conversion of tri-substituted into tetra-substituted alkenes, or late-stage alkylation of complex alkenes, would provide access to molecules that are currently difficult to construct. Alkene cross-metathesis can formally alkylate appropriately substituted alkenes, but diastereoselectivity and alkene–alkyl combinations are restricted to specific cases2, and several classes of alkenes, such as internal or cyclic alkenes, cannot be readily alkylated with known methods3. Here we report a formal regio- and diastereoselective C−H alkylation of alkenes with carboxylic acids as alkyl source, readily available in large diversity. Key to the development is a polar decarboxylative alkylation that deviates from the current model of radical-mediated C−C bond formation from carboxylic acid derivatives, enabled by a previously unappreciated access to persistent alkylzinc intermediates from redox-active esters. A Pd-catalysed cross-coupling of the alkylzinc species with alkenyl thianthrenium salts accessed from

alkenes affords the substituted alkenes in high diastereoselectivity. The transformation offers alkylation of cyclic, acyclic, terminal, internal, mono-substituted, di-substituted and tri-substituted alkenes with diverse alkyl groups.

BIOLOGY

Polymerase trapping as the mechanism of H5 highly pathogenic avian influenza virus genesis

Mathis Funk, Monique I Spronken, et al.

Abstract

Highly pathogenic avian influenza viruses (HPAIVs) derive from H5 and H7 low pathogenic avian influenza viruses (LPAIVs). Although insertion of a furin-cleavable multibasic cleavage site (MBCS) in the hemagglutinin gene was identified decades ago as the genetic basis for the LPAIV-to-HPAIV transition, the mechanisms underlying the occurrence of insertion are unknown. Here, we show that transient H5 RNA structures, predicted to trap the influenza virus polymerase on purine-rich sequences, drive nucleotide insertions, providing empirical evidence of RNA structure involvement in MBCS acquisition. Introduction of H5-like sequences and structures into an H6 hemagglutinin resulted in MBCS-yielding insertions. Our results show that nucleotide insertions that underlie H5 HPAIV emergence result from an RNA structure–driven diversity-generating mechanism, which could also occur in other RNA viruses.

Functional gradients facilitate tactile sensing in elephant whiskers

Andrew K Schulz, Lena V Kaufmann, et. al

Abstract

Keratin composites enable animals to hike with hooves, fly with feathers, and sense with skin. Mammalian whiskers are elongated keratin rods attached to tactile skin structures that extend the animal’s sensory volume. We investigated the whiskers that cover Asian elephant (Elephas maximus) trunks and found that they are geometrically and mechanically tailored to facilitate tactile perception by encoding contact location in the amplitude and frequency of the vibrotactile signal felt at the whisker base. Elephant whiskers emerge from armored trunk skin and shift from a thick, circular, porous, stiff base to a thin, ovular, dense, soft tip. These functional gradients of geometry, porosity, and stiffness independently tune the neuromechanics of elephant trunk touch to facilitate highly dexterous manipulation while ensuring whisker

durability.

Expanding the human proteome with microproteins and peptideins

Eric W. Deutsch, Leron W. Kok, et. al

Abstract

A major scientific drive is to characterize the protein-coding genome, which is a primary basis for studying human health. But the fundamental question remains of what has been missed in previous analyses. Over the past decade, the translation of non-canonical open reading frames (ncORFs) has been observed across human cell types and disease states[1,2,3], with major implications for biomedical science. However, a key gap in knowledge has been which ncORFs produce small microproteins or alternative protein molecules that contribute to the human proteome. Here we report the collaborative efforts of the TransCODE Consortium[4] to produce a consensus landscape of protein-level evidence for ncORFs. We show that about 25% of a set of 7,264 ncORFs gives rise to detectable peptides in a large-scale analysis of 95,520 proteomics experiments. We develop an annotation framework for ncORF-encoded microproteins as human proteins and codify the new conceptual model of ‘peptideins’ as microproteins that have indeterminate potential as functional proteins. To probe the biological implications of peptideins, we create an evolutionary analysis approach, termed ORF relative branch length (ORBL), and determine that evolutionary constraint is common and associates with observation of ncORF-derived peptides. We then characterize a pan-essential cellular phenotype for one peptidein from the *OLMALINC* long non-coding RNA. Overall, we generate public research tools supported by GENCODE and PeptideAtlas and advance biomedical discovery for understudied components of the human proteome.

Ⅲ Calling for papers

ICMTA 2026

Submission deadline: **Jun 10, 2026**
Conference date: **Oct 28, 2026 - Oct 30, 2026**
Full name: **International Conference on Materials Technology and Applications**
Location: **Tokyo, Japan**

Welcome to the official website of 2026 The 11th International Conference on Materials Technology and Applications (ICMTA 2026). The conference will be held from October 28 to 30, 2026 in Tokyo, Japan, providing great opportunity for materials technology and applications participants to meet researchers in other related fields as well.

ICMTA 2026 would be an excellent international conference for sharing knowledge and results in Materials Technology and Applications. Its aim to provide a platform to the researchers and practitioners from both academia as well as industry to meet the share cutting-edge development in the field. The primary goal of the conference is to exchange, share and distribute the latest research and theories from our international community.

Call for papers:

The topics of interest for submission include, but are not limited to:
Advanced Materials' Characterization
Advanced Materials' Manufacturing and Processing
All classes of materials: metals, ceramics, polymers and composites
Civil Engineering Applications
Electronic, Magnetic and Photonic Materials
Energy Production, Transport and Storage
Industrial Applications
Materials for Different Applications
Mechanics of Materials
Medical Applications
Nanomaterials
Nanotechnologies
Phase Diagrams Modeling
Processing Modeling
Recycling and Sustainability
Smart Materials
Surface Science and Engineering
Transport and Mechanical Engineering Applications
Trends in Product Development

LMAM 2026(EI)

Submission deadline: **Jun 12, 2026**
Conference date: **Jun 26, 2026 - Jun 28, 2026**
Full name: **International Academic Conference on Lasers, Materials, and Advanced Manufacturing**
Location: **Wenzhou, China**

To promote the green, standardized, sustainable, and healthy development of photonics science, materials, and manufacturing in our country, enhance technological innovation capabilities, advance interdisciplinary integration and the combination of industry, academia, and research, and understand the major critical theoretical and technical challenges, the 2026 International Academic Conference on Lasers, Materials, and Advanced Manufacturing (LMAM 2026) will be held in Wenzhou, China, from June 26 to 28, 2026. The conference will focus on the latest research achievements in the fields of lasers, materials, and advanced manufacturing, providing an international platform for experts, professors, scholars, and engineers from universities, research institutes, and enterprises at home and abroad to share professional experiences, expand professional networks, exchange new ideas face-to-face, and showcase research results. It will discuss the critical challenges and research directions facing the development of this field, aiming to promote the development and application of theories and technologies in universities and enterprises, as well as to establish business or research connections for participants and find global partners for future careers.

Topics of Interest :

◕ Lasers & Applications
- The basic principles of lasers
- Design and optimization of laser processing systems
- Advanced laser processing technology
- ……

◕Materials Science and Engineering
- Materials
- Bonding materials
- Amorphous/crystalline materials

……

◕ Advanced manufacturing technology
- Mechanomics
- Mechanical transmission theory
- Frictional wear theory

……

ICNMM 2026

Submission deadline: **Jul 5, 2026**
Conference date: **Nov 22, 2026 - Nov 24, 2026**
Full name: **International Conference on Nanomaterials, Materials and Manufacturing Engineering**
Location: **Toyama, Japan**

2026 8th International Conference on Nanomaterials, Materials and Manufacturing Engineering (ICNMM 2026) will be held in Toyama, Japan during November 22-24, 2026.
ICNMM will bring together the top researchers from Asian Pacific nations, North America, Europe and around the world to exchange their research results and address open issues in biomaterials, biomedical manufacturing, casting and solidification, characterisation, coatings and surface engineering, composite materials, etc. and address academic/industrial issues in welding, joining, additive manufacturing. It is one of the leading international conferences for presenting novel and fundamental advances in the fields of nanomaterials, materials and manufacturing engineering.

Call for Papers:
Topics of interest include, but are not limited to, the following:

Material Science and Engineering:
Composites
Micro / Nano Materials
Steel and Iron

Mechanical and Manufacturing Engineering:
Mechanical and Materials Engineering
Aerodynamics
Aerospace Systems and Technology
...

GMMT 2026 (EI)

Submission deadline: Aug 29, 2026
Conference date: Oct 9, 2026 - Oct 11, 2026
Full name: International Conference on Green Materials and Manufacturing Technology
Location: University of Cambridge, UK

The 2nd International Conference on Green Materials and Manufacturing Technology (GMMT 2026) will take place from 9 to 11 October 2026 at Gonville & Caius College, University of Cambridge. This follows the successful inaugural conference held in June 2025 at Churchill College, University of Cambridge. The conference aims to bring together leading researchers, established scientists, early-career researchers, industry experts and policymakers to discuss the latest developments in sustainable materials and innovative manufacturing techniques.

***Call for papers:**

The topics of interest for submission include, but are not limited to:
◕ Biodegradable materials
Synthesis and Application of Bio-based Polymers
Development of Natural Fiber Reinforced Composites
Functionalization of compostable materials
……

◕ Recycling of garbage and waste
Waste recycling and reuse technology
Harmless treatment and resource utilization of waste incineration fly ash
Extraction of rare metals from e-waste
……

◕ Green Paint and Coatings
Research and development of environmentally friendly waterborne coatings
Application of functional coatings in surface treatment of materials
Development of non-volatile organic compound (VOC) coatings
……

◕ Additive Manufacturing (3D Printing)
Applications of sustainable materials in additive manufacturing
Energy efficiency optimization of additive manufacturing process
Additive manufacturing of multifunctional materials
……

◕ Intelligent manufacturing and green production
Internet of Things node and gateway design
Internet of things security and privacy
……

ICCME 2026

Submission deadline: Jul 10, 2026
Conference date: Nov 25, 2026 - Nov 28, 2026
Full name: International Conference on Chemical and Material Engineering
Location: Osaka, Japan

ICCME2026 provides an international forum for presentation of original research results, as well as exchange and dissemination of innovative, practical development experiences. ICCME draws researchers and application developers from a wide range of Chemical and Material Engineering. By promoting novel, high quality research findings, and innovative solutions to challenging Chemical and Material Engineering problems, the conference seeks to continuously advance the state-of-the-art in Chemical and Material Engineering.

Topics of interest

Topics of interest include, but are not limited to:

Material Science and Engineering
Materials for Energy Harvesting and Storage
Materials for Data Storage
Materials for Electronic and Optical Applications
Concrete
Masonry Materials
Structural Materials
Building Materials
Biomaterials
Nanomaterials
Polymers
Composites
Synthesis, Properties or Applications of Materials
Heat Treatment Processes
Testing, Evaluation and Characterization of Materials
Geochemistry and Health
Chemical Engineering Fundamentals
Chemical Engineering Educational Challenges and Development
Physical, Theoretical and Computational Chemistry
Chemical Reaction Engineering
Chemical Engineering Equipment Design and Process Design
Catalysis & Reaction