Science Newsletter

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Contents

Editor: Chaoyi Chu（褚朝奕） TEL: 3548 Email: ccy@jsut.edu.cn

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 **Chemistry**:
We post several papers which are related to the top concerned topics of researches on Chemistry. The papers are classified in 5 categories, and they are: **Polymers, Catalysis, Chemical Synthesis, Physical Chemistry** and **Biological Chemistry**. 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.

POLYMERS

Nat Commun (impact factor: 14.7) 1 区

Heat-stable protein PGSL1 enhances pollen germination and tube growth at high temperature

Dong Qian, Tian Li, et. al

Abstract:
Global warming intensifies extreme heat events, threatening crop reproduction by impairing pollen development, germination, and tube growth. However, the mechanisms underlying pollen heat responses remain elusive. The actin cytoskeleton

and actin-binding proteins (ABPs) are crucial in these processes, yet their roles under heat stress are poorly understood. Here, we identify a mutant, pollen germination sensitive to LatB (pgsl1), via forward genetic screening. PGSL1 encodes a heat-stable, plant-specific ABP that binds and stabilizes actin filaments (F-actin), preventing heat-induced denaturation. High temperatures reduce F-actin content but promote bundling in pollen tubes. Notably, pgsl1 mutants exhibit decreased F-actin abundance and bundling under heat stress compared to wild-type plants. These findings highlight PGSL1 as a key regulator of actin dynamics, essential for pollen heat tolerance, offering potential strategies to enhance crop resilience in a warming climate.

Nano Lett (impact factor: 9.6) 2 区 TOP

Fabrication of Robust GO Composite Membranes through Novel Polyether Ether Ketone Weaving Strategies for Organic Solvent Nanofiltration.

Zhao, Cao, et. al

Abstract:

Fabrication of crystalline, robust graphene oxide (GO) OSN membranes is promising yet highly challenging. Herein, we prepare a SPEEK@GO/PEEK solvent-resistant composite membrane by novel weaving strategies. Among the process, SPEEK is seen as the "line", repaired of broken small pieces of GO. This facile weaving can significantly improve the separation performance and the whole stability of the membrane and effectively remove small dyes in organic solvents. The stable composite membrane exhibited excellent performance and high solvent permeance for organic solvents (DMF, 22.71 L·m-2·h-1·bar-1; acetone, 121.77 L·m-2·h-1·bar-1). The rejection rate of Acid fuchsin (AF,585 Da) exceeded 92% in DMF. The membranes exhibited excellent stability. Even after ultrasound, solvent immersion, high temperature treatment, fouling by BSA, and a long operation process, the composite membrane still maintains its original microstructure and separation performance. Taken together, this work may provide considerations in designing high performance and robust GO membranes with a stable interface.

Mikrochim Acta (impact factor: 5.3) 2 区

A rare multi-emission metal-organic complex fluorescent probe for direct oxytetracycline recognition.

Yuan, Yu, et. al

Abstract:

A simple and effective metal-organic coordination polymer, EuIn@MOCPs, which enables the rapid and selective detection of oxytetracycline (OTC) among tetracycline antibiotics was successfully synthesized. Unlike the previously reported rare-earth-doped metal-organic complexes, this probe not only exhibits the common 617-nm

characteristic peak in response to OTC but also uniquely generates uncommon peak shifts at 591 nm and 652 nm, allowing it to specifically recognize OTC among tetracycline antibiotics. We found that the response of the probe and OTC had a linear relationship with a detection limit as low as 42.3 nM within the 0-90-μM concentration range using multi-peak ratio fluorescence testing. Finally, the rich color change from blue to red in fluorescence makes this probe an excellent candidate for the development of high-performance visual fluorescent test strips. This achievement provides an effective approach for fluorescent probes to recognize structurally similar contaminants.

CATALYSIS

Nature (impact factor: 50.5) 1 区 TOP

Histone H1 deamidation facilitates chromatin relaxation for DNA repair

Yuan Tian, Tingting Feng, et. al

Abstract:
The formation of accessible chromatin around DNA double-strand breaks is essential for their efficient repair1. Although the linker histone H1 is known to facilitate higher-order chromatin compaction2,3, the mechanisms by which H1 modifications regulate chromatin relaxation in response to DNA damage are unclear. Here we show that CTP synthase 1 (CTPS1)-catalysed deamidation of H1 asparagine residues 76 and 77 triggers the sequential acetylation of lysine 75 following DNA damage, and this dual modification of H1 is associated with chromatin opening. Mechanistically, the histone acetyltransferase p300 showed a preference for deamidated H1 as a substrate, establishing H1 deamidation as a prerequisite for subsequent acetylation. Moreover, high expression of CTPS1 was associated with resistance to cancer radiotherapy, in both mouse xenograft models and clinical cohorts. These findings provide new insights into how linker histones regulate dynamic chromatin alterations in the DNA damage response.

Sci Bull (Beijing) (impact factor: 18.8) 1 区

Orbital hybridizations in single-atom catalysts for electrocatalysis.

Qi, Guan, et al

Abstract:
Single-atom catalysts (SACs) are rapidly standing at the forefront of catalytic development due to their unique structures with significantly different catalytic activity,

selectivity, and stability from conventional nanocatalysts. The electronic properties and catalytic performances of SACs hinge on the results of orbital hybridization of isolated central atoms with ligand atoms as well as of central atoms with bonding atoms provided by intermediates. Therefore, we conduct multifaceted explorations around orbital hybridizations in single-atom catalysis to elucidate the structure-activity relationships. Firstly, we introduce the basic theoretical knowledge related to orbital hybridizations, and summarize the main descriptors of orbital hybridizations, focusing on the discussion of the types of orbital hybridizations in single-atom catalysis. Then, we briefly sum up the application of orbital hybridizations in single-atom electrocatalysis and put forward important strategies for regulating orbital hybridizations in SACs to improve the catalytic performances. Finally, we present a personal perspective on the future challenges and opportunities of orbital hybridizations in single-atom catalysis.

Angew Chem Int Ed Engl (impact factor: 16.1) 1 区 TOP

Construction of Nonadjacent Stereocenters Through Iridium-Catalyzed Desymmetric Hydroheteroarylation of Cyclopentenes.

Lin, Zhao, Shi, et. al

Abstract:
Transition metal catalyzed direct addition of (hetero)aryl C-H bond to an alkene provides an expedited route to construct benzylic stereocenter from readily available arene and alkene feedstocks with complete atom-economy. However, creation of more than one stereocenter through enantioselective C-H (hetero)arylation remains a challenging goal. Here we report an iridium-catalyzed desymmetric hydroheteroarylation of cyclopentenes to construct 1,3-nonadjacent stereocenters. A series of heteroaryl C-H bonds were cleaved site-selectively and added regio- and enantioselectively to an unactivated alkene containing an amide coordinating group, delivering valuable enantioenriched cyclopentane scaffolds containing 1,3-tertiary-tertiary or 1,3-quaternary-tertiary stereocenters with exclusive diastereoselectivity and excellent enantioselectivity.© 2025 Wiley‐VCH GmbH.

CHEMICAL SYNTHESIS

Nucleic Acids Res (impact factor: 16.6) 2 区 TOP

Naphthalene diimide-naphthalimide dyads promote telomere damage by selectively targeting multimeric G-quadruplexes.

Abstract:
G-quadruplex (G4) nucleic acid ligands have attracted significant attention as putative anticancer agents for selectively stabilizing telomeric structures. In our pursuit of targeting the most biologically relevant telomeric structures, we have investigated a new class of naphthalene diimide (NDI)-based ligands designed to bind multimeric G4s. The NDI unit covalently linked with one 1,8-naphthalimide (NI) moiety, results in ligands able to fold into a sandwich-like conformation fitting into the binding pockets of telomeric multimeric G4s, thus optimizing binding complementarity. Varying the NDI decorations, we synthesized a small library of NDI-NI dyads and then examined their capability of stabilizing G4s by biophysical assays. Given the relevance of G4 stabilizing agents in fighting cancer, the most promising NDI-NIs were evaluated for their antitumoral activity on a panel of human cell lines originating from different tumor histotypes. Obtained results evidenced that three of the selected ligands promoted an accumulation of telomere-localized damage leading to a robust impairment of cell viability, regardless of homologous recombination status. These data, then confirmed in advanced 3D models, paved the way for the advancement of NDI-NIs as a new class of clinically relevant antitumoral agents. Finally, computational analyses gained deeper insight into their binding modality.© The Author(s) 2025. Published by Oxford University Press on behalf of Nucleic Acids Research.

J Am Chem Soc (impact factor: 14.4) 1 区 TOP

Highly Active and Air-Stable Iron Phosphide Catalyst for Reductive Amination of Carbonyl Compounds Enabled by Metal-Support Synergy.

Tsuda, Ishikawa, et. al

Abstract:
Iron has long been recognized as an ideal catalytic material for sustainable chemistry. However, conventional iron catalysts employed in liquid-phase hydrogenation reactions suffer from poor activity and air instability, severely restricting their wide applicability in practical use. Herein, we present the development of highly active and air-stable iron phosphide nanocrystal immobilized on zirconia (Fe2P NC/ZrO2) for the reductive amination of aldehydes and ketones. The Fe2P NC/ZrO2 catalyst demonstrated broad substrate applicability, high recyclability, and scalability in both gram-scale and continuous-flow processes. This catalyst leverages the synergistic metal-support effect of Fe2P NCs and ZrO2 support, leading to activity 313 times higher than that of conventional iron nanoparticle catalysts. In-depth mechanistic studies elucidated that the distinctive interplay between Fe2P and ZrO2 significantly accelerates ammonolysis of Schiff bases, a key step for boosting reaction efficiency. This study sets a new benchmark for iron-based catalysis, offering a robust alternative to precious metals, thereby contributing significantly to sustainable chemical

manufacturing and green organic synthesis.

ACS Appl Mater Interfaces (impact factor: 8.3) 2 区 TOP

Lipidated SNAPP-Stars Target and Kill Multidrug-Resistant Bacteria within Minutes.

Hadjigol, Shabani, et. al

Abstract:

The fast emergence of bacteria resistance has already threatened global health, and immediate action is required before the emergence of another global pandemic. Despite substantial progress in the chemical synthesis of novel antimicrobial compounds and advancements in understanding antimicrobial resistance, there has been only a handful of new antibiotics coming to the market. Structurally Nanoengineered Antimicrobial Peptide Polymers (SNAPP-stars) are a new class of antimicrobials. Here, we show that lipidation of lysine-valine 16-armed SNAPP-star, S16 (lipo-SNAPP-star) where the N-terminal arms are conjugated with different fatty acids (caproic, C6, lauric, C12, and stearic acid, C18) enhanced the antimicrobial activity toward S. aureus and MRSA. Lipidation enhanced activity by targeting the SNAPP-stars to the bacterial surface by binding to peptidoglycan, leading to greater inner membrane disruption and depolarization. Lipo-SNAPP-stars killed bacteria in under a minute, whereas vancomycin took >16 h. Lipo-SNAPP-stars were found to preferentially target and kill MRSA rather than S. aureus in a mixed bacteria model. Lipid chain length affected activity, with C6-S16 having greater activity compared to C12-S16 > C18-S16. Lauric and stearic acid enhanced SNAPP-star binding to the bacterial surface and membrane depolarization but impeded SNAPP-stars' ability to transit through the peptidoglycan layer to disrupt the inner membrane. Microbial flow cytometry showed that lipidation aided binding to bacteria via lipoteichoic acid and specifically to peptidoglycan. Further, lipid length enhanced bacterial binding with C18-S16 > C12-S16 > C6-S16 = S16, which contrasts the activity order of C6-S16 > S16 ≫ C12-S16 ≫ C18-S16. Our data demonstrate that lipidation enhances antimicrobial activity by targeting and binding an antimicrobial to peptidoglycan, but increasing lipid length reduces activity by retaining the antimicrobial in the outer layer. Lipidation of SNAPP-stars did not increase cytotoxicity, with C6-S16 having an improved therapeutic index compared to S16. Our data show how lipidation of SNAPP-stars enhances its antimicrobial activity, resulting in a highly biocompatible antimicrobial that targets and kills the "superbug" MRSA within minutes.

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PHYSICAL CHEMISTRY

Nature (impact factor: 50.5) 1 区 TOP

Observation of plastic ice VII by quasi-elastic neutron scattering

Maria Rescigno, Alberto Toffano, Ji, et. al

Abstract

Water is the third most abundant molecule in the universe and a key component in the interiors of icy moons, giant planets and Uranus- and Neptune-like exoplanets[1,2,3]. Owing to its distinct molecular structure and flexible hydrogen bonds that readily adapt to a wide range of pressures and temperatures, water forms numerous crystalline and amorphous phases[4,5,6]. Most relevant for the high pressures and temperatures of planetary interiors is ice VII (ref. 4), and simulations have identified along its melting curve the existence of a so-called plastic phase[7,8,9,10,11,12] in which individual molecules occupy fixed positions as in a solid yet are able to rotate as in a liquid. Such plastic ice has not yet been directly observed in experiments. Here we present quasi-elastic neutron scattering measurements, conducted at temperatures between 450 and 600 K and pressures up to 6 GPa, that reveal the existence of a body-centred cubic structure, as found in ice VII, with water molecules showing picosecond rotational dynamics typical for liquid water. Comparison with molecular dynamics simulations indicates that this plastic ice VII does not conform to a free rotor phase but rather shows rapid orientational jumps, as observed in jump-rotor plastic crystals[13,14]. We anticipate that our observation of plastic ice VII will affect our understanding of the geodynamics of icy planets and the differentiation processes of large icy moons.

Nat Commun (impact factor: 14.7) 1 区

Molecular structure and enzymatic mechanism of the human collagen hydroxylysine galactosyltransferase GLT25D1/COLGALT1

Matteo De Marco, Sristi Raj Rai, Liu, et. al

Abstract

During collagen biosynthesis, lysine residues undergo extensive post-translational modifications through the alternate action of two distinct metal ion-dependent enzyme families (i.e., LH/PLODs and GLT25D/COLGALT), ultimately producing the highly conserved α-(1,2)-glucosyl-β-(1,O)-galactosyl-5-hydroxylysine pattern. Malfunctions in these enzymes are linked to developmental pathologies and extracellular matrix alterations associated to enhanced aggressiveness of solid tumors. Here, we characterized human GLT25D1/COLGALT1, revealing an elongated head-to-head homodimeric assembly. Each monomer encompasses two domains (named GT1 and

GT2), both unexpectedly capable of binding metal ion cofactors and UDP-α-galactose donor substrates, resulting in four candidate catalytic sites per dimer. We identify the catalytic site in GT2, featuring an unusual Glu-Asp-Asp motif critical for Mn2+ binding, ruling out direct catalytic roles for the GT1 domain, but showing that in this domain the unexpectedly bound Ca2+ and UDP-α-galactose cofactors are critical for folding stability. Dimerization, albeit not essential for GLT25D1/COLGALT1 activity, provides a critical molecular contact site for multi-enzyme assembly interactions with partner multifunctional LH/PLOD lysyl hydroxylase-glycosyltransferase enzymes.

Nat Commun (impact factor: 14.7) 1 ☒

An anisotropic strategy for developing polymer electrolytes endowing lithium metal batteries with electrochemo-mechanically stable interface

Jingren Gou, Kaixuan Cui, et. al

Abstract

Developing versatile solid polymer electrolytes is a reasonable approach to achieving reliable lithium metal batteries but is still challenging due to the nonuniform lithium deposition associated with the sluggish Li+ kinetics and insufficient mechanical strength. Herein, the concept of developing anisotropic solid polymer electrolyte is realized via integrating polymer hosts with highly oriented polyacrylonitrile nanofibers modified by Li6.4La3Zr1.4Ta0.6O12 particles. The oriented composite structure is employed to homogenize Li+ flux, serving as a physical barrier to resist lithium dendrites, retarding the side reaction between the electrolyte and lithium, thus endowing a compatible interface for lithium negative electrode. Correspondingly, the Li||LiFePO4 cells steadily operate over 1000 cycles, delivering durable capacity retention of 91% at 170 mA g-1. Furthermore, numerical modeling and density functional theory are combined to clarify the multiphysics interplay between the designed solid polymer electrolyte and lithium negative electrode. This work provides a perspective for constructing interface-friendly solid polymer electrolytes at an electrochemo-mechanical level.

BIOLOGICAL CHEMISTRY

Biol Direct (impact factor: 5.7) 2 ☒

AQP5 trafficking is regulated by its C-terminal tail and interaction with prolactin-inducible protein

Claudia D'Agostino, Egor Zindy, et. al

Abstract

Background

Aquaporin-5 (AQP5) is a crucial membrane protein involved in water transport across cellular membranes, particularly within exocrine glands such as salivary glands. Dysregulation of AQP5, including its mislocalization, has been associated with various diseases, emphasizing the need to understand the molecular mechanisms governing its trafficking. This study investigates the multifaceted regulatory mechanisms of AQP5 trafficking, with specific emphasis on the role of the carboxyl-terminal (C-terminal) tail and the functional involvement of prolactin-inducible protein (PIP) as an interacting protein partner.

Methods

An innovative 2D-custom model employing SNAP-tag human AQP5 constructs together with a novel automated algorithm-based methodology was used following immunofluorescence and confocal microscopy to assess hAQP5 localization to the plasma membrane of stably transfected normal salivary gland-SV40 transformed-acinar cells (NS-SV-AC). The expression of the constructs was verified by Western blot analysis.

Results

The expression of SNAP-hAQP5 constructs expressed in stably transfected NS-SV-AC cells allowed to explore the involvement of hAQP5 C-terminal tail and the hAQP5-hPIP interaction in hAQP5 trafficking upon stimulation. The use of C-terminal truncation constructs revealed distinct responses to intracellular 3',5'-cyclic adenosine monophosphate (cAMP) and calcium increase, shedding light on the importance of specific regions within the highly flexible distal part of the C-terminal tail for AQP5 trafficking. Furthermore, our investigation of the interplay between hAQP5 and hPIP revealed that PIP promotes AQP5 translocation to the plasma membrane, blunting the effects of calcium- and cAMP-dependent pathways on AQP5 sub-cellular localization.

Conclusion

In summary, this study advances our understanding of AQP5 trafficking dynamics and provides critical insights into the regulatory roles of the C-terminal tail and its interaction with PIP. The innovative methodology to assess AQP5 translocation to the plasma membrane sets the stage for future investigations to identify the role of individual amino acids and phosphorylation sites within the distal AQP5 C-terminus in the trafficking mechanism and protein-protein interaction, and to explore the dynamic of the process by high resolution live cell imaging. Further research in this area is warranted to uncover critical insights into the regulation of AQP5, offering opportunities for the development of innovative therapeutic strategies.

J Am Heart Assoc (impact factor: 5) 1 ☒

Global Burden of Cardiovascular Disease Attributable to Sugar-Sweetened Beverages in Middle-Aged Adults: An Age-Period-Cohort Modelling Study.

Abstract:
Cardiovascular disease (CVD) presents a significant burden among middle-aged adults (aged 35-64). Diet high in sugar-sweetened beverages is a notable CVD risk factor.Using Global Burden of Disease data from 1990 to 2019, age-standardized rates (ASRs) and average annual percentage change of ASRs were used to describe this burden and its changing trend.In 2019, global CVD-related ASR (per 100 000) of deaths attributable to sugar-sweetened beverages in middle-aged adults reached 1.91 (95% uncertainty interval [UI], 1.07-2.63) compared with 2.75 (95% UI, 1.76-3.59) in 1990. The global ASR of disability-adjusted life years (DALYs) reached 69.71 in 2019 (95% UI, 38.38-96.36) compared with 97.98 (95% UI, 62.29-128.39) in 1990. Men had more than twice the deaths and DALYs as women. Low and low-middle sociodemographic index regions exhibited a higher burden of DALYs and deaths. In 2019, India and China had the highest numbers of deaths and DALYs and the Solomon Islands and Afghanistan recorded the highest ASRs of deaths and DALYs. A negative linear correlation was observed between sociodemographic index and ASRs of deaths (R=-0.10, P=0.010) and DALYs (R=-0.09, P=0.031) across 21 Global Burden of Disease regions. An inequalities analysis indicated that DALYs due to CVD were disproportionately higher in countries with lower sociodemographic index in 2019 (concentration index of inequality=-0.05 [95% CI, -0.1 to -0.01]).Globally, sugar-sweetened beverages have contributed to a substantial increase in DALYs and deaths related to CVD in middle-aged adults over the past 30 years, especially among men and in low sociodemographic index countries.

J Am Heart Assoc (impact factor: 5) 1 ☒

Endothelial Cell Senescence in Marfan Syndrome: Pathogenesis and Therapeutic Potential of TGF-β Pathway Inhibition.

Chen, Zhu, Ren, et. al

Abstract:
Marfan syndrome (MFS) is a heritable connective tissue disorder caused by mutations in the Fibrillin-1 gene, which encodes the extracellular matrix protein fibrillin-1. Patients with MFS are predisposed to aortic aneurysms and dissections, significantly contributing to mortality. Emerging evidence suggests that endothelial cell (EC) senescence plays a critical role in the pathogenesis of aortic aneurysms in MFS. This study aims to elucidate the role of EC senescence in the development of aortic aneurysms in MFS using a vascular model derived from human induced pluripotent stem cells.We generated human induced pluripotent stem cells lines from 2 patients with MFS carrying specific Fibrillin-1 mutations and differentiated these into ECs. These MFS-hiPSC-derived ECs were characterized using immunofluorescence, reverse transcription-quantitative polymerase chain reaction, and Western blotting. Functional assays including cell proliferation, scratch wound, tube formation, NO content

detection, and senescence-associated β-galactosidase staining were conducted. RNA sequencing was performed to elucidate underlying signaling pathways, and pharmacological inhibition of the transforming growth factor-beta pathway was assessed for its therapeutic potential. MFS-hiPSC-derived ECs recapitulated the pathological features observed in Marfan aortas, particularly pronounced cellular senescence, decreased cell proliferation, and abnormal transforming growth factor-beta and NF-κB signaling. These senescent ECs exhibited diminished proliferative and migratory capacities, reduced NO signaling, increased production of inflammatory cytokines, and attenuated responses to inflammatory stimuli. Importantly, senescence and dysfunction in MFS-hiPSCderived ECs were ameliorated by transforming growth factor-beta signaling pathway inhibitor, SB-431542, suggesting a potential therapeutic strategy.This study highlights the pivotal role of endothelial cell senescence in the pathogenesis of aortic aneurysms in MFS. Our human induced pluripotent stem cells-based disease model provides new insights into the disease mechanisms and underscores the potential of targeting the transforming growth factor-beta pathway to mitigate endothelial dysfunction and senescence, offering a promising therapeutic avenue for MFS.

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Ⅱ Concentration

PHYSICS

Nonlinear sound-sheet microscopy: Imaging opaque organs at the capillary and cellular scale

Baptiste Heiles, Flora Nelissen, et al.

Abstract

Light-sheet fluorescence microscopy has revolutionized biology by visualizing dynamic cellular processes in three dimensions. However, light scattering in thick tissue and photobleaching of fluorescent reporters limit this method to studying thin or translucent specimens. In this study, we applied nondiffractive ultrasound beams in conjunction with a cross-amplitude modulation sequence and nonlinear acoustic reporters to enable fast and volumetric imaging of targeted biological functions. We reported volumetric imaging of tumor gene expression at the cubic centimeter scale using genetically encoded gas vesicles and localization microscopy of cerebral capillary networks using intravascular microbubble contrast agents. Nonlinear sound-sheet microscopy provides a ~64× acceleration in imaging speed, ~35× increase in imaged volume, and ~4× increase in classical imaging resolution compared with the state of the art in biomolecular ultrasound.

Microsatellite-based real-time quantum key distribution

Li, Yang, Cai, et al.

Abstract

A quantum network1,2,3 provides an infrastructure that connects quantum devices with revolutionary computing, sensing and communication capabilities. A quantum satellite constellation offers a solution to facilitate the quantum network on a global scale4,5. The Micius satellite has verified the feasibility of satellite quantum communications6,7,8,9; however, scaling up quantum satellite constellations is challenging, requiring small lightweight satellites, portable ground stations and real-time secure key exchange. Here we tackle these challenges and report the development of a quantum microsatellite capable of performing space-to-ground quantum key distribution using portable ground stations. The microsatellite payload weighs approximately 23 kilograms, and the portable ground station weighs about 100 kilograms, representing reductions by more than 1 and 2 orders of magnitude, respectively. Using this set-up, we demonstrate satellite-based quantum key distribution with multiple ground stations and achieve the sharing of up to 1.07 million bits of secure

keys during a single satellite pass. In addition, we multiplex bidirectional satellite–ground optical communication with quantum communication, enabling key distillation and secure communication in real time. Also, a secret key, enabling one-time pad encryption of images, is created between China and South Africa at locations separated by over 12,900 kilometres on Earth. The compact quantum payload can be readily assembled on existing space stations10,11 or small satellites12, paving the way for a satellite-constellation-based quantum and classical network for widespread real-life applications.

Water structure and electric fields at the interface of oil droplets

Shi, Lixue, LaCour, et al.

Abstract

Interfacial water exhibits rich and complex behaviour[1], playing an important part in chemistry, biology, geology and engineering. However, there is still much debate on the fundamental properties of water at hydrophobic interfaces, such as orientational ordering, the concentration of hydronium and hydroxide, improper hydrogen bonds and the presence of large electric fields[2,3,4,5]. This controversy arises from the challenges in measuring interfacial systems, even with the most advanced experimental techniques and theoretical approaches available. Here we report on an in-solution, interface-selective Raman spectroscopy method using multivariate curve resolution[6,7] to probe hexadecane-in-water emulsions, aided by a monomer-field theoretical model for Raman spectroscopy[8]. Our results indicate that oil–water emulsion interfaces can exhibit reduced tetrahedral order and weaker hydrogen bonding, along with a substantial population of free hydroxyl groups that experience about 95 cm^{-1} redshift in their stretching mode compared with planar oil–water interfaces. Given the known electrostatic zeta potential characteristic of oil droplets[9], we propose the existence of a strong electric field (about 50–90 MV cm^{-1}) emanating from the oil phase. This field is inferred indirectly but supported by control experiments and theoretical estimates. These observations are either absent or opposite in the molecular hydrophobic interface formed by small solutes or at planar oil–water interfaces. Instead, water structural disorder and enhanced electric fields emerge as unique features of the mesoscale interface in oil–water emulsions, potentially contributing to the accelerated chemical reactivity observed at hydrophobic–water interfaces[10,11,12,13].

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MATERIALS

Strain-induced rubidium incorporation into wide-bandgap perovskites reduces photovoltage loss

Likai Zheng, Mingyang Wei, et al.

Abstract

A-site cation mixing can enhance the photovoltaic performance of a wide-bandgap (WBG) perovskite, but rubidium (Rb) cation mixing generally forms a nonperovskite phase. We report that lattice strain locks Rb ions into the α-phase of the lattice of a triple-halide WBG perovskite, preventing phase segregation into a nonperovskite Rb-cesium–rich phase. This process cooperates with chloride accommodation and promotes halide homogenization across the entire film volume. The resulting 1.67–electron volt WBG perovskite exhibits photoluminescence quantum yields exceeding 14% under 1-sun-equivalent irradiation, corresponding to a quasi–Fermi level splitting of ~1.34 electron volts. A WBG perovskite solar cell with an open-circuit voltage (VOC) of 1.30 volts was prepared, corresponding to 93.5% of the radiative VOC limit and representing the lowest photovoltage loss relative to the theoretical limit observed in WBG perovskites.

Superior resistance to cyclic creep in a gradient structured steel

Qingsong Pan, Kunqing Ding, et al.

Abstract

Cyclic creep, or ratcheting, is a severe form of fatigue deformation caused by cumulative unidirectional plastic strain under asymmetrical stress cycling with a nonzero mean stress. It often causes premature failure of structural materials, and enhancing ratcheting resistance is a challenge in materials engineering. We demonstrate superior ratcheting resistance in high-strength austenitic stainless steel with a gradient hierarchy of dislocation cells. The ratcheting rate is two to four orders of magnitude lower than for coarse-grained counterparts. Its resistance results from sustained microstructural refinement through deformation-induced coherent martensitic transformations to hexagonal close-packed nanolayers within stable dislocation cells. The progressively refined microstructure mitigates cyclic softening and suppresses strain localization during stress cycling, thus reducing ratcheting strain. The gradient dislocation architecture represents a promising design for high-strength, ratcheting-resistant materials.

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Cooper-pair density modulation state in an iron-based superconductor

Kong, Lingyuan, Papaj, et al.

Abstract

Superconducting (SC) states that break space-group symmetries of the underlying crystal can exhibit nontrivial spatial modulation of the order parameter. Previously, such states were intimately associated with the breaking of translational symmetry[1,2], resulting in the density-wave orders[3,4,5,6,7,8], with wavelengths spanning several unit cells[9,10,11,12,13,14,15,16,17,18,19]. However, a related basic concept has long been overlooked[20]: when only intra-unit-cell symmetries of the space group are broken, the SC states can show a distinct type of nontrivial modulation preserving long-range lattice translation. Here we refer to this new concept as the pair density modulation (PDM) and report the first observation of a PDM state in exfoliated thin flakes of the iron-based superconductor $FeTe_{0.55}Se_{0.45}$. Using scanning tunnelling microscopy (STM), we discover robust SC gap modulation with the wavelength corresponding to the lattice periodicity and the amplitude exceeding 30**%** of the gap average. Notably, we find that the observed modulation originates from the large difference in SC gaps on the two nominally equivalent iron sublattices. The experimental findings, backed up by model calculations, suggest that, in contrast to the density-wave orders, the PDM state is driven by the interplay of sublattice symmetry breaking and a peculiar nematic distortion specific to the thin flakes. Our results establish new frontiers for exploring the intertwined orders in strong-correlated electronic systems and open a new chapter for iron-based superconductors.

CHEMISTRY

Homogeneous-heterogeneous bifunctionality in Pd-catalyzed vinyl acetate synthesis

Deiaa M. Harraz, Kunal M. Lodaya, et. al

Abstract

Presently, mechanistic paradigms in catalysis generally posit that the active species remains either homogeneous or heterogeneous throughout the reaction. In this work, we show that a prominent industrial process, palladium (Pd)–catalyzed vinyl acetate synthesis, proceeds via interconversion of heterogeneous Pd(0) and homogeneous Pd(II) during catalysis, with each species playing a complementary role. Using electrochemical probes, we found that heterogeneous, nanoparticulate Pd(0) serves as an active oxygen reduction electrocatalyst to furnish the high potential required for

corrosion to form homogeneous Pd(II), which then catalyzes selective ethylene acetoxylation with reformation of heterogeneous Pd(0). Inhibiting the corrosion of Pd(0) to Pd(II) by galvanic protection results in reversible poisoning of catalysis, evincing the essential role of phase conversion in this catalytic cycle. These results highlight how dynamic phase interconversion can harness and couple complementary reactivity across molecular and material active sites.

Photoinduced copper-catalysed deracemization of alkyl halides

Zhong, Feng, Li, Renhe, et. al

Abstract

Deracemization is an emerging strategy for generating enantioenriched compounds wherein the two enantiomers of a readily available racemic starting material are transformed into a single enantiomer, typically through the action of a light-induced catalyst[1,2]. Excellent proof of principle for this potentially powerful approach to asymmetric catalysis has been described[3,4,5,6,7,8]; nevertheless, substantial challenges have not yet been addressed, including the exploitation of carbon–heteroatom (rather than only carbon–hydrogen and carbon–carbon) bond cleavage to achieve deracemization, as well as the development of processes that provide broad classes of useful enantioenriched compounds and tetrasubstituted stereocentres. Here we describe a straightforward method that addresses these challenges, using a chiral copper catalyst, generated in situ from commercially available components, to achieve the photoinduced deracemization of tertiary (and secondary) alkyl halides through carbon–halogen bond cleavage. Mechanistic studies (including the independent synthesis of postulated intermediates, photophysical, spectroscopic and reactivity studies, and density functional theory calculations) provide support for the key steps and intermediates in our proposed catalytic cycle, as well as insight into the origin of enantioselectivity.

Phosphate-enabled mechanochemical PFAS destruction for fluoride reuse

Yang, Long, Chen, et. al

Abstract

Perfluoroalkyl and polyfluoroalkyl substances (PFASs) are persistent, bioaccumulative and anthropogenic pollutants that have attracted the attention of the public and private sectors because of their adverse impact on human health[1]. Although various technologies have been deployed to degrade PFASs with a focus on non-polymeric functionalized compounds (perfluorooctanoic acid and perfluorooctanesulfonic acid)[2,3,4], a general PFAS destruction method coupled with fluorine recovery for upcycling is highly desirable. Here we disclose a protocol that converts multiple classes

of PFAS, including the fluoroplastics polytetrafluoroethylene and polyvinylidene fluoride, into high-value fluorochemicals. To achieve this, PFASs were reacted with potassium phosphate salts under solvent-free mechanochemical conditions, a mineralization process enabling fluorine recovery as KF and K_2PO_3F for fluorination chemistry. The phosphate salts can be recovered for reuse, implying no detrimental impact on the phosphorus cycle. Therefore, PFASs are not only destructible but can now contribute to a sustainable circular fluorine economy.

BIOLOGY

A geological timescale for bacterial evolution and oxygen adaptation

Adrián A. Davín, Ben J. Woodcroft, et al.

Abstract

Microbial life has dominated Earth's history but left a sparse fossil record, greatly hindering our understanding of evolution in deep time. However, bacterial metabolism has left signatures in the geochemical record, most conspicuously the Great Oxidation Event (GOE). We combine machine learning and phylogenetic reconciliation to infer ancestral bacterial transitions to aerobic lifestyles, linking them to the GOE to calibrate the bacterial time tree. Extant bacterial phyla trace their diversity to the Archaean and Proterozoic, and bacterial families prior to the Phanerozoic. We infer that most bacterial phyla were ancestrally anaerobic and adopted aerobic lifestyles after the GOE. However, in the cyanobacterial ancestor, aerobic metabolism likely predated the GOE, which may have facilitated the evolution of oxygenic photosynthesis.

Human high-order thalamic nuclei gate conscious perception through the thalamofrontal loop

Zepeng Fang, Yuanyuan Dang, et. al

Abstract

Human high-order thalamic nuclei activity is known to closely correlate with conscious states. However, it is not clear how those thalamic nuclei and thalamocortical interactions directly contribute to the transient process of human conscious perception. We simultaneously recorded stereoelectroencephalography data from the thalamic nuclei and prefrontal cortex (PFC), while patients with implanted electrodes performed a visual consciousness task. Compared with the ventral nuclei and PFC, the intralaminar

and medial nuclei presented earlier and stronger consciousness-related activity. Transient thalamofrontal neural synchrony and cross-frequency coupling were both driven by the θ phase of the intralaminar and medial nuclei during conscious perception. The intralaminar and medial thalamic nuclei thus play a gate role to drive the activity of the PFC during the emergence of conscious perception.

Exogenous RNA surveillance by proton-sensing TRIM25

Myeonghwan Kim, Youngjoon Pyo, et. al

Abstract

Exogenous messenger RNAs (mRNAs) require cellular machinery for delivery and translation but also encounter inhibitory factors. To investigate their regulation, we performed genome-wide CRISPR screens with in vitro–transcribed mRNAs in lipid nanoparticles (LNPs). Heparan sulfate proteoglycans (HSPGs) and vacuolar adenosine triphosphatase (V-ATPase) were identified as mediators of LNP uptake and endosomal escape, respectively. TRIM25—an RNA binding E3 ubiquitin ligase—emerged as a key suppressor inducing turnover of both linear and circular mRNAs. The endoribonucleases N4BP1 and KHNYN, along with the antiviral protein ZAP, act redundantly in TRIM25-dependent surveillance. TRIM25 specifically targets mRNAs delivered by endosomes, and its RNA affinity increases at acidic pH, suggesting activation by protons released from ruptured endosomes. N1-methylpseudouridine modification reduces TRIM25's RNA binding, helping RNAs evade its suppressive effect. This study comprehensively maps cellular pathways regulating LNP-mRNAs, offering insights into RNA immunity and therapeutics.

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Ⅲ Calling for papers

CHENG 2025

Submission deadline: **Apr 19, 2025**
Conference date: **Jun 26, 2025 - Jun 27, 2025**
Full name: **International Conference on Advances in Chemistry & Chemical Engineering**
Location: **Virtual Conference**

2nd International Conference on Advances in Chemistry & Chemical Engineering (CHENG 2025) will provide an excellent international forum for sharing knowledge and new research results in all areas of Chemistry & Chemical Engineering. The goal of this conference is to bring together researchers and practitioners from academia and industry to focus on areas of Chemistry & Chemical Engineering for a cross cultural exploration and subsequent innovation of subjects concerned and establishing new collaborations in these areas. Authors are solicited to contribute to this conference by submitting articles for the development of Chemistry & Chemical Engineering. The conference documents practicaland theoretical results which make a fundamental contribution for the development of Chemistry & Chemical Engineering.

Call for papers:

Advanced Manufacturing Technology
Analytical Chemistry
Biological Chemistry
Catalysis / Synthesis
Environmental Chemistry
Materials, Polymers & Nanoscience
Organic Chemistry
Physical Chemistry / Chemical Physics
Theoretical and Computational Chemistry Biotechnology and Bio-Systems Engineering
Catalysis and Reaction Engineering
Energy
Environment
Materials Engineering / Nanotechnology / Polymer
Process Systems Engineering
Transport, Colloids, and Interface Science

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IJAC 2025

Submission deadline: **Apr 20, 2025**
Conference date: **N/A**
Full name: **International Journal of Advances in Chemistry**
Location: **N/A**

International Journal of Advances in Chemistry (IJAC) is a peer-reviewed, open access journal, addresses the impacts and challenges of Chemistry. The journal documents practical and theoretical results which make a fundamental contribution for the development of Chemistry.
Authors are invited to submit papers for this journal through E-mail ijrcjournal@airccse.com. Submissions must be original and should not have been published previously or be under consideration for publication while being evaluated for this Journal.
Submissions are accepted for review with the understanding that the same work has been neither submitted to, nor published in, another publication. Simultaneous submission to other publications will result in immediate rejection of the paper. Papers are not within the journal scope will be rejected immediately after the pre review process.
All manuscripts will be subject to a well established, fair, unbiased peer review and refereeing procedure, and are considered on the basis of their significance, novelty and usefulness to the Journals readership. The reviewing structure will always ensure the anonymity of the referees & it will be reviewed by 3 experts in the field. The review output will be one of the following decisions:
1. Accept
2. Accept with Minor changes
3. Weak Accept with Major changes
4. Reject

Topics of Interest :
The topics of interest for submission include, but are not limited to:
Analytical Chemistry
Biological Chemistry
Catalysis / Synthesis
Environmental Chemistry
Materials, Polymers & Nanoscience
Organic Chemistry
Physical Chemistry / Chemical Physics
Theoretical and Computational Chemistry

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ICBBE 2025

Submission deadline: **Jul 5, 2025**
Conference date: **Nov 27, 2025 - Nov 30, 2025**
Full name: **International Conference on Biomedical and Bioinformatics Engineering**
Location: **Tokyo, Japan**

2025 12th International Conference on Biomedical and Bioinformatics Engineering (ICBBE 2025). ICBBE 2025 will be held during November 27-30, 2025 at The University of Tokyo, Tokyo, Japan. ICBBE 2025 is supported by Ritsumeikan University, Taipei University of Technology, East China Normal University, Shanghai Key Laboratory of Multidimensional Information Processing, the Biology and Bioinformatics Society (BBS). Previously, the papers of ICBBE have been published in the Conference Proceedings by ACM and indexed by Ei Compendex and Scopus for 9 years.
In the past 9 years, ICBBE 2016-2024 papers published in ACM Conference Proceedings and archived in ACM Digital Library, indexed by Ei Compendex and Scopus. After a careful reviewing process by at least 2-3 experts, all accepted and registered papers for the ICBBE 2025 will be published in the following Conference Proceedings.
Option A: International Conference Proceedings, indexed by Ei Compendex and Scopus, and submitted to be reviewed by CPCI (ISI Web of Science).
Option B: Presentation Only-The authors who do not want to publish papers can submit abstract for presentation only.

Call for Papers:
(Included but not limited)
1.Biomedical Image Processing and Analysis: Medical image reconstruction and enhancement/ Medical image segmentation and registration/Medical image feature extraction and classification/Medical image visualization and visual analytics/ Medical image retrieval and detection
2. Bioinformatics and Computational Biology: Genomics and proteomics analysis/ Bio-molecular sequence analysis and alignment/ RNA structure and function prediction/Biological network analysis and systems biology/Protein structure prediction and simulation
3. Health Informatics and Medical Data Analytics: Medical data mining and big data analytics/Health information management and electronic health records/ Health monitoring and sensor technologies
4. Biomedical Signal Processing and Pattern Recognition: Biomedical signal processing and analysis/ Biomedical signal feature extraction and classification/ Biomedical signal pattern recognition and diagnosis
5.Biomedical Engineering and Medical Devices: Medical sensors and biosignal measurements/Medical imaging and diagnostic devices/Medical robotics and rehabilitation engineering

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ICCME 2025

Submission deadline:	**Jul 10, 2025**
Conference date:	**Nov 21, 2025 - Nov 24, 2025**
Full name:	**International Conference on Chemical and Material Engineering**
Location:	**Osaka, Japan**

After the immensely successful ICCME2024 (Nagoya, Japan), ICCME2023 (Fukuoka, Japan), ICCME2022 (Tokyo, Japan), ICCME2021 & 2020 (Virtual Conference), ICCME2019 (Nanyang Technological University), ICCME2018 (Beijing), ICCME2014-2017, we are expecting ICCME2025, the 12th anniversary of ICCME, to be more exciting, stimulating & educative.
Welcome to 2025 the 12th International Conference on Chemical and Material Engineering (ICCME 2025), will be held in Osaka, Japan during November 21-24, 2025 as the workshop of ICMSET 2025. ICCME2025 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.

***Call for papers:**
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

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EUCHEMBIOJ 2025

Submission deadline:	**Jul 30, 2025**
Conference date:	**Dec 5, 2025 - Dec 7, 2025**
Full name:	**International Conference on Chemistry and Biotechnology**
Location:	**Istanbul**

The aim of "EUCHEMBIOJ 2025: II. International Conference on Chemistry and Biotechnology" is to investigate the rapidly developing topic of biotechnology and to bring together researchers in the field of Chemistry and Biotechnology.
The topics discussed at the conference include application areas of biotechnology such as biomedical technology, biosensors, molecular biology, medicine, environment, agriculture, nanotechnology, and chemistry studies for application in the field of chemistry and biotechnology. Leading experts from around the world will come together at the conference to share their studies, perspectives, and ideas on the latest developments in biotechnology. This dynamic and multidisciplinary field will be fully explored at the conference, from cutting-edge technologies to creative applications, from fundamental concepts to theoretical frameworks.
The conference will take place online on December 5 – 7, 2025, based in Istanbul, Türkiye.

Topics of interest

Novel protein, enzyme, antibody etc. studies in which molecules are synthesized by living organisms with up-to-date techniques (recombinant DNA technology, etc.),
Modern biotechnology research involving gene manipulation techniques,
Medication and treatment applications,
Drug design,
Studies on the production of industrial products with traditional biotechnological methods,
Biotechnology and chemistry research for the green environment
Biosensor studies
Nanobiotechnology applications
Biofuel cell technology research (enzymatic fuel cells, microbial electrochemical cells, microbial fuel cells, microbial electrolysis cells)
Chemistry studies with application in biotechnology
Computational chemistry, organic synthesis, chemical engineering (catalysis, chemical reaction engineering, etc.), electrochemistry, bioelectrochemistry research, etc.
Ethical, societal, legal considerations arising in one or more of the above topics

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