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 **Environmental Engineering**:
We post several papers which are related to the top concerned topics of researches on Environmental Engineering. The papers are classified in 5 categories, and they are: **Clean Energy, Ecological System, Global climate change, Wastewater Treatment** and **Carbon Emission**. 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.

CLEAN ENERGY

Adv Mater (impact factor: 26.8) 1 区 TOP

Gradient-Heterojunction in Solid Electrolytes for Fast-Charging Dendrite-Free Solid-State Lithium Metal Batteries.

Liyu Du, Chenke Tang, et. al

Abstract:
Solid-state batteries (SSBs) employing thin polymer electrolytes and lithium (Li) metal anodes are regarded as promising next-generation energy storage systems due to their potential to deliver high energy density with enhanced safety. However, their practical application is impeded by the inherently low ionic conductivity of polymer electrolytes

and the uncontrollable growth of Li dendrites. Herein, we design a composite electrolyte with enhanced ionic conductivity and dendrite suppression by introducing gradient Li2TiO3/Li4Ti5O12 (LTO) heterojunction fillers. The heterojunction, formed through lattice mismatch, generates a built-in electric field (IEF) that promotes Li salt dissociation and forms continuous ion-conduction pathways, thereby enhancing ionic conductivity to 0.83 mS cm-1 at room temperature. Furthermore, under an external field, the charged LTO particles redistribute directionally, producing a gradient structure with higher concentration near the Li side. This gradient IEF ensures uniform Li^+ flux at the Li-electrolyte interface, while the reinforced mechanical strength effectively blocks dendrite propagation. Consequently, symmetric Li||Li cells with PTLT-H demonstrate stable cycling for over 1000 h at 1 mA cm-2 (1 mAh cm-2). Moreover, PTLT-H enables SSBs with excellent long-term performance, achieving 94.6% capacity retention after 5000 cycles at 5C. This study highlights gradient IEF engineering as a viable approach to achieving both high conductivity and interfacial stability in fast-charging dendrite-free SSBs.

J Environ Manage (impact factor: 8.4) 2 区

Mapping the asymmetric dynamics between ESG uncertainty and clean energy: A quantile-wavelet framework.

Aslan Aydoğdu, Mesut Dogan, et. al

Abstract:

The primary objective of this study is to investigate the impact of the ESG-based Sustainability Uncertainty Index (ESGUI) on clean energy markets. We examine how this impact changes across different quantiles and time scales, thereby revealing the impacts of sustainability uncertainties on clean energy markets. Using a monthly dataset covering the period from July 31, 2015 to June 30, 2025, five indices are employed to represent clean energy markets: S&P Global Clean Energy Transition Index (GCEI), S&P Kensho Clean Energy Index (KCEI), Renewable Energy Industrial Index (RENIXX), MSCI Global Alternative Energy Index (MSCIGA), and MSCI ACWI IMI Clean Energy Infrastructure Index (MSCIACWI IMI). Quantile on Quantile Regression (QQR), Wavelet Quantile Regression (WQR), and Quantile on Quantile Granger Causality (QQGC) methods are employed in the study. The empirical findings indicate that ESG-based sustainability uncertainties exhibit heterogeneous, nonlinear, and asymmetric effects on clean energy markets, depending on both the quantile and the time scale. QQR and WQR analyses reveal that uncertainties have particularly strong negative effects during market declines, evolving into a more persistent and suppressive structure in the medium and long term. The QQGC results highlight the persistent predictive power of ESG uncertainties, guiding investor behavior during both downturns and upturns. The results offer important insights that investors should consider when shaping their risk management strategies and policymakers when developing regulatory frameworks to accelerate the energy transition.Copyright © 2025

Bioelectrochemistry (impact factor: 4.5) 2 区

Smart nanostructured electrodes integrated with microbial fuel cells for wastewater-to-energy conversion and on-site detection of antibiotic in real wastewater.

Tukendra Kumar, Satya Jujjavarapu, et. al

Abstract:

Detection of ciprofloxacin (CIP) is crucial due to its persistence and frequent occurrence in water bodies. An algal microbial fuel cell (MFC) integrated with an electrospun carbon nanotube-polyaniline-zinc oxide (CNT-PANI-ZnO) nanofiber electrode was developed for simultaneous renewable energy generation and CIP detection. The electrode enhanced electron transfer efficiency, enabling sensitive monitoring of voltage changes during CIP analysis. The electrode properties were characterized using scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), ultraviolet-visible (UV-Vis) spectroscopy, zeta potential, and contact angle analyses. Bio-electrochemical performance was assessed using linear sweep voltammetry (LSV), cyclic voltammetry (CV), and electrochemical impedance spectroscopy (EIS). The algal MFC achieved a maximum power density of 27.57 ± 0.95 mW m-3 at a current density of 46.73 ± 0.57 mA m-2 with an internal resistance of 22 Ω. CIP was detected with a minimum limit of 0.5 μg L-1 and a sensitivity of 0.1568 mV (μg L-1)-1 under stable voltage conditions. The system exhibited reusability over three operational cycles. These findings demonstrate the potential of CNT-PANI-ZnO-based algal MFCs as eco-friendly platforms for sustainable energy conversion and real-time contaminant sensing.

ECOLOGICAL SYSTEM

Trends Plant Sci (impact factor: 20.8) 1 区 TOP

Nonhistone deacetylation: a switch for crop resilience.

Minghui Xing, Lam-Son Tran, et al

Abstract:

HISTONE DEACETYLASE (HDAC)-mediated nonhistone deacetylation is an evolutionarily conserved post-translational modification (PTM) essential for plant

stress adaptation. Recently, two HDAC modules involved in plant responses to drought and pathogens, respectively, were functionally analyzed by Liu et al. and Zhang et al., providing evidence that biotic and abiotic stress-triggered relief of deacetylation functions as a switch for crop resilience.

J Environ Manage (impact factor: 8.4) 2 ☒

Global ecological risk assessment of soil contamination by heavy metal(loid)s based on machine learning.

Wenqi Jiao, Mengting Wu, et. al

Abstract:

Soil contamination by heavy metal(loid)s, due to their persistence and bioaccumulation potential, has emerged as a global environmental issue. Rapid and accurate identification of soil contamination risk levels is critical for ensuring ecosystem safety and human health. In this study, a machine learning-based framework for multi-class classification was developed to identify and interpret ecological risk levels associated with soil contamination by heavy metal(loid)s. Based on 9489 soil samples collected from multiple countries and regions, a comprehensive dataset encompassing soil properties, metal(loid) descriptors, and total metal(loid) content was constructed. The performance of six commonly used machine learning classification models was systematically evaluated, with hyperparameter tuning applied to enhance overall model performance. Model interpretation techniques were employed to elucidate the relationships between ecological risk levels associated with soil contamination by heavy metal(loid)s and input features. The results demonstrated that the categorical boosting model outperformed others on both training and testing sets, achieving an accuracy of 0.681 and an area under the curve (AUC) value of 0.885 on the testing set. Permutation importance analysis identified total metal(loid) content, pH, organic carbon, clay, cation exchange capacity, and electron affinity as key features influencing risk levels classification, with partial dependence plots and Shapley additive explanations further characterizing their nonlinear impact on predictions. This study presents a novel approach for developing effective and interpretable systems to rapidly identify ecological risk levels associated with soil contamination by heavy metal(loid)s, providing a scientific basis and priority restoration guidance for global contamination management and sustainable land management.

New Phytol (impact factor: 8.1) 1 ☒ TOP

Linking root phosphatase activity to root chemical and morphological traits across species: a global analysis.

Abstract:

Root phosphatase activity (RPA) is a key physiological trait that indicates plant phosphorus (P) acquisition ability, representing significant carbon investment and P gain. However, it is unclear how RPA is coordinated with key traits for nutrient acquisition. We analyzed a global dataset across 514 species from 83 studies to investigate how RPA is correlated with other key traits and its position within the global root economics space (RES) framework. We found that RPA exhibits significant coordination and trade-off with root morphological traits, yet remains independent of root branching and mycorrhizal colonization. Root nitrogen (N) and P concentrations were positively and negatively correlated with RPA, respectively. Moreover, we observed significantly higher RPA in N-fixers than in nonfixers, demonstrating the higher P-mining ability of N-fixers. Incorporating RPA into the classic RES, our findings support the multidimensional RES framework, showing a closer alignment of RPA with the acquisitive end of the conservation dimension. Our findings clarify how RPA is integrated into the global RES and contribute to an integrative understanding of plants' belowground strategies, with implications for plant form and ecosystem functioning.

GLOBAL CLIMATE CHANGE

Lancet Planet Health (impact factor: 21.6) 1 ☒

Estimating non-optimal temperature-attributable burden of Salmonella and Campylobacter infections under various climate change, population, and adaptation scenarios in Australia: a comparative risk assessment modelling study.

Yohannes Damtew, Blesson Varghese, et. al

Abstract:

Salmonella and Campylobacter infections are leading causes of bacterial gastrointestinal infections, with rising global incidence. Rising temperatures are expected to further drive the transmission and prevalence of enteric infections. Quantifying the current and future burden of Salmonella and Campylobacter infections is crucial for guiding prevention strategies. This study aimed to assess the present and projected burden of Salmonella and Campylobacter infections attributable to rising temperatures in Australia.In this comparative risk assessment modelling study, disability-adjusted life-years (DALYs) associated with Salmonella and Campylobacter

infections from 2003 to 2018 were acquired from the Australian Institute of Health and Welfare and analysed. A meta-regression model was employed to estimate the increase in infection risk per 1°C rise in temperature. Exposure distributions for each Köppen-Geiger climate zone were calculated and compared with the theoretical minimum risk exposure to establish the burden attributable to rising temperatures. Projected burdens for the 2030s and 2050s were assessed under two representative concentration pathways (RCP4.5 and RCP8.5), considering population growth and adaptation scenarios.Between 2003 and 2018, rising temperatures attributed to 11% (41·8 [SD 2·8] DALYs) of Salmonella and 8% (28·1 [1·8] DALYs) of Campylobacter burden. The highest burden was in the tropical rainforest climate zone. By the 2050s, under RCP8.5 and medium population growth without adaptation, Salmonella and Campylobacter burdens could reach 100·6 (10·9) and 67·9 (7·4) DALYs, respectively. A 10% adaptation measure could reduce these to 89·5 (8·3) and 61·8 (6·7) DALYs.This study presents the first national assessment of the temperature-attributable burden of Salmonella and Campylobacter infections in Australia. It addresses a substantial knowledge gap by providing data-driven projections and underscores the necessity for targeted public health interventions and region-specific climate adaptation strategies to mitigate enteric infection risks.Australian Research Council Discovery Program.

Carbon Balance Manag (impact factor: 5.8) 2 ☒

Spatiotemporal variations in dissolved organic carbon in China's major river basins and their associations with climate change and human activities

Yanru Sun, Anzhi Wang, et. al

Abstract:

Riverine dissolved organic carbon (DOC) is a vital element of regional carbon cycling, yet its magnitude and influencing factors remain poorly quantified. Existing large uncertainties in the distribution, trends, and drivers of DOC compromise the accuracy of terrestrial carbon budget estimations. This study compiled 1922 DOC data points from literature on four major Chinese river basins (i.e., the Songhua River Basin, Yellow River Basin, Yangtze River Basin, and Pearl River Basin) for the period 1997–2023. The spatiotemporal patterns and driving mechanisms of DOC in these basins were quantified and systematically analyzed. Key results are as follows: [1] Spatially, DOC concentration (CDOC) exhibited a distinct "north high, south low" pattern nationally, while DOC flux (FDOC) displayed an inverted "south high, north low" distribution. Temporally, CDOC in the four basins all showed a statistically significant increasing trend, with an average annual rise of 0.04 mg L^{-1} yr^{-1}. Meanwhile, the FDOC into the sea in the Yangtze River Basin and Yellow River Basin also exhibited a statistically significant increase, with an average annual growth of 0.05 Tg yr^{-1} [3].

Attribution analysis indicated that the spatiotemporal distribution of CDOC was influenced by both climatic factors and human activities, whereas that of FDOC was controlled primarily by streamflow. The findings of this study reflect the national distribution and dynamics of DOC in major Chinese rivers, and provide a valuable framework together with details of key parameters to support future research into global riverine carbon cycle models.

Risk Anal (impact factor: 3.3) 3 ☒ TOP

Know Your Stripes? An Assessment of Climate Warming Stripes as a Graphical Risk Communication Format.

Ian Dawson, Danni Zhang, et. al

Abstract:

Stripe graphs have emerged as a popular format for the visual communication of environmental risks. The apparent appeal of the format has been attributed to its capacity to summarize complex data in an eye-catching way that can be understood quickly and intuitively by diverse audiences. Despite the growing use of stripe graphs among academics and organizations (e.g., Intergovernmental Panel on Climate Change [IPCC]) to communicate with both lay and expert audiences, there has been no reported empirical assessment of the format. Hence, it is not clear to what extent stripe graphs facilitate data comprehension and influence risk perceptions and the willingness to engage in mitigation actions. To address these knowledge gaps, we conducted two studies in which lay participants saw "climate warming" stripe graphs that varied in color and design. We found no evidence that traditional stripe graphs (i.e., unlabeled axes), irrespective of the stripe colors, improved the accuracy of estimates of past or predicted global temperature changes. Nor did the traditional stripe graph influence risk perceptions, affective reactions, or environmental decision-making. Contrary to expectations, we found that viewing (cf., not viewing) a traditional stripe graph led to a lower willingness to engage in mitigation behaviors. Notably, we found that a stripe graph with date and temperature labels (cf., without labels): (i) helped participants develop more accurate estimates of past and predicted temperature changes and (ii) was rated more likable and helpful. We discuss how these and other findings can be utilized to help improve the effectiveness of stripe graphs as a risk communication format.

J Hazard Mater (impact factor: 11.3) 1 区 TOP

Diffusion behavior and potential risk of intestinal pathogenic bacteria and chemicals in aerosols from outdoor desilting basin of six urban sewage treatment plants.

Tong Gao, Wenwen Wang, et. al

Abstract

Domestic wastewater transports a substantial quantity of pathogenic bacteria as it migrates, flows, and accumulates in the urban sewage treatment plants (USTPs). The desilting basin, situated in the influent zone, releases pathogenic bacteria that disperse into the surrounding atmospheric environment as aerosols, primarily resulting from mechanical disturbances, water flow scouring, and aeration. However, research on bioaerosol emissions originating from desilting basins is limited. Therefore, we aimed to elucidate the circumstances of aerosol emissions, focusing on the desilting basins of six USTPs in North, East, and South China, and comparing the emission characteristics, diffusion behavior, and health risks associated with intestinal pathogenic bacteria (IPB) in bioaerosols generated by aeration and cyclone processes. IPB concentration was the highest in North China (71 ± 8 CFU/m³), comprising 2.19-5.32 % of the total bacteria, while that in East China was 3.10 %. Atmospheric variables including temperature, humidity, and wind speed exhibited notable positive correlations with the concentrations of total bioaerosols and IPB. Aerosol emissions during the aeration process were markedly higher than those during the cyclone process, with total suspended particulate concentrations observed to be 1.3-2.6 times higher in the former. After diffusion, IPB dropped below 1 CFU/m³ at the distance of 1.6 km, with their dispersion primarily influenced by wind directions. This research offers foundational data and decision-making assistance for formulating scientifically more informed public health policies, enhancing wastewater treatment methodologies, and implementing environmental protection strategies.

J Hazard Mater (impact factor: 11.3) 1 区 TOP

Quaternary phosphonium compounds as emerging contaminants in wastewater treatment plant: Occurrence, removal, and river discharge impact.

Longxin Zhang, Pinjie Su, et. al

Abstract

Organophosphorus pollutants have raised increasing concern in aquatic environments

due to their widespread use and toxicological effects. While some organophosphate pollutants have been extensively studied, quaternary phosphonium compounds (QPCs) represent a class of emerging contaminants receiving limited attention. This study investigated the occurrence, removal efficiency, and discharge of QPCs in a wastewater treatment plant (WWTP) in Northern China, which receives wastewater from a chemical park containing a QPC manufacturing factory. A total of 16 QPCs were detected in this study. Concentrations of ΣQPCs in the WWTP influent and effluent were 464 ± 34 ng/L and 212 ± 30 ng/L, respectively. The WWTP achieved moderate removal efficiencies for QPCs (45-78 %), primarily through adsorption and advanced oxidation processes. QPCs were detected in surface water (1.76-138 ng/L) and sediment (1.13-2.14 × 103 ng/g) of a river receiving the WWTP effluent. Notably, two of these QPCs were identified in the environment for the first time. Mass balance analysis indicated that the WWTP effluent was the major source of QPCs to the receiving river, accounting for 84 % of the total load. Risk quotient assessments in the river indicated moderate ecological risks to fish and daphnia, largely attributable to long-chain QPCs and (methoxymethyl)triphenylphosphonium. Overall, the detection of these QPCs significantly expands our understanding of organophosphorus pollutants, highlighting the need for increased attention to their occurrence and toxicity in aquatic environments.

J Environ Manage (impact factor: 8.4) 2 ☒

Mechanisms of enhanced synergistic pollution reduction and carbon fixation induced by microalgal-bacterial interactions within different biofilm structures.

Chao Li, Kang Liu, Xinming Wu, et. al

Abstract

Microalgae can achieve simultaneous pollutant removal and carbon fixation in wastewater treatment. However, unimicrobial algal systems face challenges of limited performance and poor biofilm adhesion. This study introduced bacteria as mediators and examined the mechanisms involved in different spatial structures of microalgal-bacterial biofilms. Results showed that, compared to the unimicrobial microalgal biofilm (UMB), the hybrid microalgal-bacterial biofilm (HMBB) and stratified microalgal-bacterial biofilm (SMBB) enhanced CO2 fixation from 20.04 % to 31.50 % and 35.30 %, respectively, with biomass increasing from 62.1 mg/g to 77.6 mg/g and 93.0 mg/g. The SMBB system exhibited the strongest enhancement, particularly in microalgal photosynthetic activity and total EPS. Protein (PN) and polysaccharide (PS) concentrations reached 57.28 mg/L and 26.45 mg/L, which were 43.27 % and 17.45 % higher than those in HMBB, respectively. The increased PN improved hydrophobicity, thereby enhancing biofilm formation and biomass accumulation in the microalgal-bacterial systems, with a bacterial-to-microalgal biomass ratio of 1:1.19, compared to 1:1.01 in HMBB. The microalgal-bacterial interaction comprised: (i) microalgae

facilitating the enrichment of pollutant-degrading bacteria (e.g., Acinetobacter and Pseudomonas); and bacterial modulation of algal metabolism through (ii) upregulation of key genes associated with photosynthetic carbon fixation (e.g., GOT1, 12.57-fold), (iii) stimulation of hydrophobic amino acid synthesis (e.g., ilvE, 12.56-fold), and (iv) activation of pathways related to nitrogen-phosphorus metabolism and the TCA cycle. In general, bacterial inoculation contributes three main advantages for microalgal: enhanced biofilm adhesion, increased carbon sequestration, and improved pollutant removal efficiency, and the stratified microalgal-bacterial biofilm (SMBB) provides the most pronounced improvement.

CARBON EMISSION

Water Res (impact factor: 12.4) 1 区 TOP

Enhancement of lake carbon emission by cyanobacteria-derived organic carbon input: Stimulatory effect of co-metabolism on sediment.

Yu Peng, Muchun Zhou, et. al

Abstract

Lake carbon emissions have increased markedly under climate warming and eutrophication, yet the underlying mechanisms remain poorly understood. Here, we reveal a clear spatiotemporal expansion of cyanobacterial blooms in Lake Taihu from 2000 to 2023 based on the floating algae index (FAI) analysis, indicating a year-on-year increase in bloom frequency and intensity. Furthermore, this study examined how cyanobacterial-derived organic matter inputs influence carbon emissions and sediment carbon pool structures across three representative zones: a cyanobacterial-dominated region, a macrophyte-dominated region, and the lake center. Field observations showed that CH4 and CO2 fluxes in the cyanobacterial-dominated region were significantly higher than in the other regions, reaching 133.9 and 2361.2 μg/m2·min, respectively. The total organic carbon (TOC) content in the surface sediment was highest at 58.5 g/kg, while microbial biomass carbon (MBC) reached 554.1 mg/kg; both declined sharply with depth. In contrast, the macrophyte-dominated region displayed the highest TOC in bottom sediment (49.5 g/kg), indicating strong carbon burial. Microcosm experiments confirmed that cyanobacterial-derived organic carbon input induced co-metabolic processes in sediments, and significantly increased CH4 and CO2 fluxes-especially in regions with high recalcitrant organic carbon (ROC) content. The relative increase in sediment carbon emissions was positively correlated with ROC and negatively with labile organic carbon (LOC). Moreover, the proportion of ROC in sediments significantly decreased before and after incubation, indicating that co-metabolism promotes ROC degradation and enhances the role of lakes as carbon

sources. However, based on microcosm experiments, where cyanobacterial input enhanced carbon emissions from sediments while TOC concentration still increased, lakes remain net carbon sinks overall. These findings improve our understanding of the role of co-metabolism in regulating lake carbon source-sink dynamics and provide critical insights for regional and global carbon assessments.

Sci Total Environ (impact factor: 8) 2 区 TOP

When less travel means more carbon: How rainfall-induced shifts from public transit to cars increase urban transport emissions.

Jinhyeok Jang, Mingyu Sung, et. al

Abstract:

Climate change is expected to increase the frequency and intensity of extreme precipitation events, with significant implications for urban mobility and the associated carbon emissions. This study examines how rainfall-induced changes in travel demand vary by mode of transportation and how these differences can alter per-passenger carbon intensity and total system-level emissions. Using daily panel data for 2024 from two administrative districts in Busan, South Korea, precipitation elasticities were estimated separately for private cars, buses, and the metro. The results show that rainfall reduces travel demand across all modes-higher rainfall can lower total system-level carbon emissions. Nevertheless, private car use is less elastic to rainfall than public transport; many car users may continue traveling in adverse weather conditions. This lower sensitivity can increase per-passenger carbon intensity in urban transport systems. Furthermore, if rainfall prompts a modal shift from public transport to private cars among mandatory trip makers, the total system emissions may increase despite an overall decline in travel demand. By combining mode-specific elasticity estimates with carbon intensity factors, this study identifies the thresholds at which rainfall-driven mode shifts result in net emission increases. These findings highlight the importance of transport adaptation strategies in mitigating the risk of adverse modal shifts resulting from changing precipitation patterns.

Carbon Balance Manag (impact factor: 5.8) 2 区

Spatiotemporal correlation analysis between carbon emission intensity and intensive use level of construction land at county scale in Chongqing of China

CAO Wei, LIU Zongyuan, ZHOU Minyu, et. al

Abstract:

The association between carbon emissions and construction intensive-use is still

unknown. As a result, this research seeks to assess the carbon emission intensity and intensive use level of construction land in 38 districts (or counties) of Chongqing from 1997 to 2015 using data from construction land and economic and social development. Simultaneously, the spatial autocorrelation analysis approach is utilized to uncover the spatial correlation and spatial distribution characteristics between carbon emission intensity and intensive usage level of construction land in each district and county. The findings indicate that: (1) Because of the influence of complicated terrain types and differences in economic-social development, heavy carbon emissions and extremely intensive use are concentrated in the central parts of cities. The two main sites for micro carbon emissions and micro intensive use are the Three Gorges Reservoir Area in Northeast Chongqing and the Wuling Mountain Area in Southeast Chongqing. (2) The global spatial autocorrelation of carbon emissions and intensive use exhibits a trend of first increasing and then dropping, but it is a high value agglomeration overall. Local spatial autocorrelation reveals that the low-value agglomeration region is primarily found in Southeast and Northeast Chongqing, while the high-value area is primarily found in urban centre areas and urban development new areas. (3) In order to create a new land-use mode with the objective of "low-carbon and intensive use," various regions should make use of various mechanisms to encourage the movement of people, land, industry, and other elements between regions. Technology development, planning advice, mode selection, and policy design are some of these tools.

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

Ⅱ Concentration

PHYSICS

Shapiro steps in strongly-interacting Fermi gases

Giulia Del Pace, Diego Hernández-Rajkov, et al.

Abstract

Driven many-body systems exhibit diverse and complex dynamical behaviors. Here, we report the observation of Shapiro steps in periodically driven Josephson junctions between strongly interacting Fermi superfluids of ultracold atoms. The height and the width of the observed quantized plateaus in the current-potential characteristics mirror the external drive frequency and the junction nonlinear response. Direct measurements of the current-phase relationship showcase how Shapiro steps arise from the synchronization between the relative phase of the two reservoirs and the external drive. Such a mechanism is further supported by the detection of periodic phase-slippage processes, in the form of vortex-antivortex pairs. Our results are corroborated by a circuital model and numerical simulations. Our work may open prospects for studying emergent nonequilibrium dynamics in quantum many-body systems under external drives.

Observation of Shapiro steps in an ultracold atomic Josephson junction

Erik Bernhart, Marvin Röhrle, et al.

Abstract

The current-voltage characteristic of a driven superconducting Josephson junction displays discrete steps. This phenomenon, called the Shapiro steps, forms today's voltage standard. In this work, we report the observation of Shapiro steps in a driven Josephson junction in a gas of ultracold atoms. We demonstrate that the steps exhibit universal features and provide insight into the microscopic dissipative dynamics that we directly observe in the experiment. We find that the steps are directly connected to phonon emission and nucleation of solitonic excitations, whose dynamics we follow in space and time. The experimental results are underpinned by extensive numerical simulations based on classical-field dynamics and may enable metrological and fundamental advances.

Mesoporous optically clear heat insulators for sustainable building envelopes

Abstract

Mesoporous materials exhibit highly controlled nanoscale structures, often templated by liquid crystalline assemblies of surfactants, with emergent and often designable physical properties. However, scaling their fabrication to be suitable for uses such as envelopes of buildings is challenging. In this work, we describe fabrication of flexible square-meter-sized films and multicentimeter-thick slabs made of three-dimensional spatial graphs of mesopore tubes that have all structural features under 50 nanometers. A solution-based kinetic fabrication process templates growing networks of cylindrical surfactant micelles with thin tubes of polysiloxane-forming gel networks and, upon replacing surfactants and solvents with air, yields lightweight materials with greater than 99% visible-range optical transparency and approximately 10 milliwatts per kelvin per meter thermal conductivity. Such predesigned metamaterials enable transparent thermal barriers for wall-grade insulated glass units, square-meter window retrofits, and unconcentrated solar thermal energy harnessing.

MATERIALS

Quantifying grain boundary deformation mechanisms in small-grained metals

Gautier, Romain, Mompiou, et al.

Abstract

Dislocations are the crystalline defects responsible for the mechanical properties of conventional metals and alloys. When they become scarce or constrained, such as in nanocrystals[1], grain-boundary-based mechanisms may compensate and lead to permanent deformation[2,3]. Shear-migration coupling is thought to be the most efficient of these processes[4,5], but despite intense research activity, no consensus has emerged to quantify the possible shear produced by a migrating grain boundary[6]. Here we show experimentally that, in small-grained polycrystals, this shear does not depend on the grain boundary misorientation and that its efficiency remains low. These findings support a new concept of grain boundaries that may not be considered as crystalline defects carrying an intrinsic 'coupling factor'[7] (similarly to the Burgers vector of a dislocation) but rather as specific lattices containing peculiar defects, known as disconnections, that will, in turn, govern the properties, at least mechanical, of grain boundaries. They also confirm that polycrystals can plastically deform without dislocations but less effectively, providing a potential path to explain the poor ductility

of nanocrystalline metals at low and room temperature.

Ferroelectric transistors for low-power NAND flash memory

Yoo, Sijung, Kim, et al.

Abstract

NAND flash memory is essential in modern storage technology, amid growing demands for low-power operation fuelled by data-centric computing and artificial intelligence[1,2]. Its unique 'string' architecture[3], where multiple cells are connected in series, requires high-voltage pass operation that causes a large amount of undesired power consumption[4]. Lowering the pass voltage, however, poses a challenge: it leads to an associated reduction in the memory window, restricting the multi-level operation capability. Here, with a gate stack composed of zirconium-doped hafnia and an oxide semiconductor channel, we report ultralow-power ferroelectric field-effect transistors (FeFETs) that resolve this dilemma. Our FeFETs secure up to 5-bit per cell multi-level capability, which is on par with or even exceeds current NAND technology, while showing nearly zero pass voltage, saving up to 96% power in string-level operations over conventional counterparts. Three-dimensional integration of FeFET stacks into vertical structures with a 25-nm short channel preserves robust electrical properties and highlights low-pass-voltage string operation in scaled dimensions. Our work paves the way for next-generation storage memory with enhanced capacity, power efficiency and reliability.

Improved solvent systems for commercially viable perovskite photovoltaic modules

Yinke Wang, Ye Liu, et al.

Abstract

Commercializing perovskite photovoltaics requires overcoming three critical barriers: the use of toxic solvents in manufacturing, variations in perovskite film quality across large areas, and limited operational reliability. Here, we address these challenges by developing a green solvent–based (γ-valerolactone/2-methyl tetrahydrofuran/dimethylsulfoxide) ink and a solvent-confinement edge-protection strategy, demonstrating large-scale manufacturing of defect-minimized perovskite films under ambient-air conditions. These approaches enabled the production of 7200-square-centimeter perovskite photovoltaic modules that achieved a total-area steady-state efficiency of 17.2% (certified by the National Renewable Energy Laboratory) and that passed all IEC 61215 reliability standards (certified by TÜV Rheinland). This work demonstrates an environmentally responsible path toward commercial manufacturing of perovskite photovoltaics.

Accelerating the discovery of multicatalytic cooperativity

Sak, Marcus H., Liu, et. al

Abstract

Cooperative catalysis, in which multiple catalytic units operate synergistically, underpins a variety of synthetically and mechanistically important organic reactions[1,2,3,4]. Despite its potential utility in new reactivity contexts, approaches to the discovery of cooperative catalysts have been limited, typically relying on serendipity or on previous knowledge of single-catalyst reactivity[1,5]. Systematic searches for unanticipated types of catalyst cooperativity must contend with vast combinatorial complexity and are therefore not undertaken[6,7,8,9,10]. Here we describe a pooling–deconvolution algorithm, inspired by group testing[11], which identifies cooperative catalyst behaviours with low experimental cost while accommodating potential inhibitory effects between catalyst candidates. The workflow was validated first on simulated cooperativity data and then by experimentally identifying previously documented cooperativity between organocatalysts in an enantioselective oxetane-opening reaction. The workflow was then applied in a discovery context to a Pd-catalysed decarbonylative cross-coupling reaction, enabling the identification of several ligand pairs that promote the target transformation at substantially lower catalyst loading and temperature than previously reported with single-ligand systems.

A stoichiometrically conserved homologous series with infinite structural diversity

Hengdi Zhao, Xiuquan Zhou, et. al

Abstract

We describe a compositionally guided structural evolution within a stoichiometrically conserved framework, $BaSbQ_3$ (Q = $Te_{1-x}S_x$), where each value of x gives rise to a distinct phase. The fundamental building blocks, A_1 ($BaSbSTe_2$) and B_n ($Ba_nSb_nS_{n-1}Te_{2n+1}$), were composed of modular double rocksalt slabs stacked with functional polytelluride zigzag chains, with each phase differing only in the size and assembly of these blocks. Ten compounds were synthesized that maintained a coherent chemical identity that arose from this isovalent, isoelectronic substitution of Te and S. We envision that the phase formation at a molecular level unfolds in stages of extension, termination, and assembly and propose a design concept of “anionic disparity,” where phase homologies and polytelluride hierarchical networks can be controlled by leveraging differences in anion electron affinity and sizes.

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

Biocatalytic, asymmetric radical hydrogenation of unactivated alkenes

Jaicy Vallapurackal, Rajib Mandal, et. al

Abstract

Alkene hydrogenation is a cornerstone of chemical synthesis, yet enzymatic strategies remain limited to electron-deficient substrates by means of hydride transfer. Using heme enzymes, we unlock a hydrogenation pathway for the asymmetric reduction of unactivated olefins. A silane-promoted heme-cysteine redox cycle in the active site catalyzes sequential hydrogen atom transfer to challenging scaffolds, including 1,1-disubstituted as well as tri- and tetrasubstituted alkenes. The evolved enzymes are promiscuous and oxygen tolerant, use Earth-abundant iron, and can operate on the gram scale under ambient conditions. Orthogonal hydrogen atom sources enable site-divergent asymmetric isotope labeling. Mechanistic and computational studies support a stepwise radical process. Our work introduces a biochemical approach for stereoselective olefin reduction and provides a platform for next-generation biocatalytic hydrogenation.

BIOLOGY

Mechanosensitive genomic enhancers potentiate the cellular response to matrix stiffness

Brian D. Cosgrove, Lexi R. Bounds, et al.

Abstract

Epigenetic control of gene expression and cellular phenotype is influenced by changes in the local microenvironment, yet how mechanical cues precisely influence epigenetic state to regulate transcription remains largely unmapped. In this study, we combined genome-wide epigenome profiling, epigenome editing, and phenotypic and single-cell RNA sequencing CRISPR screening to identify a class of genomic enhancers that responds to the mechanical microenvironment. These “mechanoenhancers” can be preferentially activated on either soft or stiff extracellular matrix contexts and regulate transcription to influence critical cell functions including apoptosis, adhesion, proliferation, and migration. Epigenetic editing of mechanoenhancers reprograms the cellular response to the mechanical microenvironment and modulates the activation of disease-related genes in lung fibroblasts from healthy and fibrotic donors. Epigenetic editing of mechanoenhancers holds potential for precise targeting of mechanically driven diseases.

Cortical glutamatergic and GABAergic inputs support learning-driven hippocampal stability

Vincent Robert, Keelin O'Neil, et. al

Abstract

Flexibility and stability of neuronal ensembles are crucial features of brain function. Little is known about how these properties of local circuits are influenced by long-range inputs. We show, in mice, that lateral entorhinal cortex glutamatergic (LEC_{GLU}) and γ-aminobutyric acid (GABA)–ergic (LEC_{GABA}) projections to CA3 recruit specific microcircuits that conjunctively provide stability to neuronal ensembles, thereby supporting learning. LEC_{GLU} drives excitation in CA3 but also substantial feedforward inhibition that prevents somatic and dendritic spikes. Conversely, LEC_{GABA} suppresses this local inhibition to disinhibit CA3 activity with compartment and pathway specificity by selectively boosting somatic output to integrated LEC_{GLU} and CA3 recurrent inputs. This synergy allows the stabilization of spatial representations relevant to learning, as both LEC_{GLU} and LEC_{GABA} control the formation and maintenance of CA3 place cells across contexts and over time.

Multispecies pangenomes reveal a pervasive influence of population size on structural variation

Scott V. Edwards, Bohao Fang, Danielle Khost, et. al

Abstract

Structural variants (SVs) are widespread in vertebrate genomes, yet their evolutionary dynamics remain poorly understood. Using 45 long-read de novo genome assemblies and pangenome tools, we analyze SVs among three closely related species of North American jays (*Aphelocoma*, scrub-jays) displaying a 55-fold range in effective population size. We find rapid evolution of genome architecture, including ~100-megabase decreases in genome size driven by shifts in complex satellite landscapes. SVs exhibit slightly deleterious dynamics modulated by variant length and population size, with consistent evidence of adaptive fixation only in the largest population. Gene copy number variants exhibit an inverse relationship with population size, indicating strongly deleterious dynamics, with consequences for gene expression. Our long-read dataset and pangenome analysis demonstrate how population size shapes genome complexity.

Ⅲ Calling for papers

ICEEEP 2026（EI）

Submission deadline:	**Nov 30, 2025**
Conference date:	**Apr 10, 2026 - Apr 12, 2026**
Full name:	**International Conference on Energy Economics and Energy Policy**
Location:	**Porto, Portugal**

Welcome to the official website of the 2026 10th International Conference on Energy Economics and Energy Policy (ICEEEP 2026). The conference will be planned in Porto, Portugal on April 10-12, 2026, co-sponsored by Polytechnic of Porto, Polytech Engineering School-University of Lille, supported by Universitetet of Agder, Norway and Galati University 'Dunarea de Jos', Romania, etc. The aim of ICEEEP 2026 is to present the latest research and results of scientists related to Energy Economics and Energy Policy topics. This conference provides opportunities to attendees from different areas to exchange new ideas and application experiences face to face, to establish business or research relations and to find global partners for future collaboration. We hope that the conference results will significantly contribute to the knowledge in these up-to-date scientific fields. The organizing committee of conference is pleased to invite prospective authors to submit their original manuscripts to ICEEEP 2026.

Call for papers:

EU, US and Chinese agendas for green energy
Trans-national and trans-continental energy cooperation
National regulations for wind, solar, biomass and geothermal power stations
Governmental incentives for green energy transitions
Air pollution and transition to green energies
Air pollution and green mobility
Impact of green mobility on industry and society
Political regulations of energy market(s)
Energy stock-exchanges
Fast online energy-trade
Energy supply/demand modeling/simulation/forecasting
Digitization of supply and demand sides
Digitization of energy economy
Influence of digitization of society on energy demand
Cyber-security of national energy systems
Country-vulnerability because of energy prices
Inexpensive green energy for developing countries
Energy behavior and demand side management
Demand response and demand-side management
Reserve markets and demand side flexibility……

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

ICESD 2026(SPRINGER)

Submission deadline: **Jan 10, 2026**
Conference date: **Jun 5, 2026 - Jun 7, 2026**
Full name: **International Conference on Environmental Science and Development**
Location: **Qingdao, China**

Welcome to the official website of the 2026 17th International Conference on Environmental Science and Development and Taishan Forum to be held during June 5-7, 2026 in Qingdao, China. ICESD 2026 is organized by Shandong University, China and co-organized by International Society for Environmental Information Sciences and United Nations Development Programme. ICESD 2026 brings together innovative academics and industrial experts to a common forum to facilitate the exchange of scientific information and its application in the field of Environmental Science and Development.

The conference aims to provide a platform for experts, scholars, engineers and researchers in related fields to share scientific research achievements and cutting-edge technologies, to comprehend academic development trends, to broaden research ideas, and strengthen academic research and discussion and to promote academic accomplishments through industrialization cooperation. Scholars from universities, scientific research institutions and other relevant enterprises will be invited to attend the conference. The conference will be held every year to make it an ideal platform for people to share views and experiences in Environmental Science and Development and related areas.

Topics of Interest :

2026 17th International Conference on Environmental Science and Development and Taishan Forum (ICESD 2026) is the premier forum for the presentation of new advances and research results in the fields of theoretical, experimental, and applied Environmental Science and Development. The conference will bring together leading researchers, engineers and scientists in the domain of interest from around the world. Topics of interest for submission include, but are not limited to:

Environmental Ecological Engineering
Ecosystem Management and Sustainable Development
Environmental Monitoring and Management
Resources and Environment Engineering
Water Resources Management and Water Pollution Control
Atmospheric science and air pollution control
Solid Waste Pollution Control and Resource Utilization

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

CEAC 2026(SPRINGER)

Submission deadline: **Jan 10, 2026**
Conference date: **Mar 20, 2026 - Mar 23, 2026**
Full name: **The 6th International Civil Engineering and Architecture Conference**
Location: **Hong Kong**

2026 The 6th International Civil Engineering and Architecture Conference (CEAC 2026) will take place on March 19-23, 2026 in Hong Kong.
Architecture is closely related to Civil Engineering. Engineering is a creative discipline and there are natural synergies with architecture and many civil engineers work closely with architects during their careers.
CEAC is for broad logical discourse, both intra-and interdisciplinary, among Universities, Colleges, Academicians and Department personnel through an assortment of Distinguished addresses, Plenary sessions, Workshops, Symposiums, Oral and Poster introductions, Virtual/Video presentations and Webinars.

Call for Papers:

Civil Engineering
Building Structure
Bridge Engineering
Structural Engineering
Coastal Engineering
Geological Engineering
Geotechnical Engineering
Hydraulic Engineering
Surveying Engineering
Seismic Engineering
Harbor Engineering
Transportation Engineering
Water Supply and Drainage Engineering
Road and Railway Engineering
Engineering Management
Heating, Gas Supply, Ventilation and Air Carrier Operation Engineering
Concrete Structures
Disaster Prevention and Mitigation
Environment-Friendly Construction and Development
Material Quality and Control
Safety and Monitoring
Monitoring and Control of Structures
Reliability and Durability of Structures
Construction Technology
Computer Simulation and CAD/CAE
Computational Mechanics
Structural Analysis and Design
Sanitary and Ground Water Engineering
Architecture
History and Theories of Architecture
Traditional Construction Materials
Architectural Design and Theories
Advanced Construction Materials
Architecture and Building Materials
Art Design and Landscape Architecture
Building Technology Science
Architectural Environment and Equipment Engineering
Green Building Materials
Ecological Architecture
Computers in Architecture
Sustainable Architecture

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

ICACER 2026(SPRINGER)

Submission deadline: **Jan 10, 2026**
Conference date: **Apr 10, 2026 - Apr 12, 2026**
Full name: **International Conference on Advances on Clean Energy Research**
Location: **Porto, Portugal**

After ICACER 2016 held in Bangkok (Thailand), ICACER 2017 in Berlin (Germany), ICACER 2018 in Barcelona (Spain), ICACER 2019 in Coimbra (Portugal), ICACER 2020-2022 (Virtual Conference), ICACER 2023 (Barcelona, Spain), ICACER 2024 (Lille, France), ICACER 2025 (Nice, France) successfully, 2026 11th International Conference on Advances on Clean Energy Research (ICACER 2026) will be planned in Porto, Portugal on April 10-12, 2026, co-sponsored by Polytechnic of Porto, Polytech Engineering School-University of Lille, supported by Universitetet of Agder, Norway and Galati University 'Dunarea de Jos', Romania, etc.
The objectives of ICACER 2026 are to provide a forum to bring together researchers, scientists, engineers, academics and graduate students in the fields of advances on clean energy research, energy economics and energy policy to share up-to-date research results. We are confident that the participants benefited from the theoretical insights, practical knowledge and personal contacts that will help them to build a long-term, profitable and sustainable communication among researchers and practitioners in the related scientific areas. It is one of the leading international conferences for presenting novel and fundamental advances in the fields of clean energy research. ICACER 2026 will focus on Clean Energy Research: Now and in the Future. Planned highlights of ICACER 2026 include:

***Call for papers:**

- Wind, solar, biomass and geothermal energies
- Ocean energy harvesting
- Energy efficiency in buildings and appliances
- Smart grids and microgrids for green electricity
- CO2 capture and storage
- Fossil-fuel power-stations with CO2 sequestration
- Underground and gas-network storages
- Future high-capacity energy-storages
- Future battery technologies
- Power-to-gas/gas-to-power-solutions
- Green fuel/energy for mobility
- Efficient long-distance transmission in supergrids
- Efficient AC/DC/AC energy conversion
- Sector coupling for energy creation and storage
- Sector coupling at the consumer side
- Coupling conventional with green power stations

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

ICEES 2026(SPRINGER)

Submission deadline:	**Jan 15, 2026**
Conference date:	**Mar 27, 2026 - Mar 29, 2026**
Full name:	**International Conference on Energy and Environmental Science**
Location:	**Shanghai, China**

As the importance of energy continues to grow globally, energy and environmental issues have become a critical intersection of resources, economy, and ecology. The rapid pace of economic development has led to increased energy demands, exacerbating environmental pollution and ecological pressures. Against this backdrop, achieving a balance between efficient energy utilization and environmental protection has become essential to ensuring energy security and advancing sustainable development. Research in this field not only drives technological innovation but also profoundly impacts the future of global ecosystems.

The 10th International Conference on Energy and Environmental Science (ICEES 2026) will be held in Shanghai, China during March 27-29, 2026, co-sponsored by Tongji University and Chongqing Jiaotong University. With the successful experience of the last nine years in Thammasat University, Thailand, University of Malaya, Malaysia, Seoul, South Korea, and Perth, Australia, as well as virtually in 2021-2023 and Chongqing in 2024-2025, In 2026, ICEES will once again provide a high-quality academic exchange platform for scholars worldwide to discuss cutting-edge research and practical achievements in energy and environmental science.

As an annual conference, ICEES is dedicated to showcasing the latest research and advancements related to energy and environmental science. It offers representatives from diverse regions an opportunity to exchange innovative ideas, applications, and experiences, build academic and professional relationships, and explore potential collaborations with global partners. The call for papers is now open, inviting all professionals and researchers in the field of energy and environmental science to submit their work. We sincerely invite you to participate in ICEES 2026.

Topics of interest

Topic 1: Alternative Energy and the Environment
Topic 2: Assessments of the Condition of Ecosystems and Environmental Quality
Topic 3: Behaviour of and Impacts of Pollutants in Atmosphere, Soil and Water
Topic 4: Management of Ecosystems, Environment and Water Resources
Topic 5: Modelling and Regional Environmental Assessments (Includes Global Change)
Topic 6: Treatment/ Restoration of Ecosystems, Environment and Water resources
Topic 7: Sustainable/Renewable Energy
Topic 8: Energy and the Built Environment
Topic 9: Energy-Saving and Heat Transfer Technologies
Topic 10: Green Building Design, Energy Efficiency in Buildings, and Building Environment Management
Topic 11: Low-Carbon Urban Planning, Landscape Design, and Related Environmental Impacts
Topic 12: Grid-Connected Renewable Energy Systems and Sustainable Energy Management
Topic 13: Carbon Emissions, Carbon Sequestration, and Carbon Reduction

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