Science Newsletter

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Contents

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Introduction:

There are 3 main elements in the Science Newsletter which is composed. In the first part, we list the most up to date papers about central issues for each discipline in our university, and they are provided with 5 subjects for a time. In the second part, there are papers from the top journals last month, and most of them are from Nature and Science. In the third part, we post information about calling papers for international conferences. Hopefully, some of the information in this manuscript may be useful for those who are dedicating to scientific career. Besides, the journals are also posted on the website of our library, and they are available to be accessed any time at https://lib.jsut.edu.cn/2024/0112/c5474a174724/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: **Renewable Energy, Ecosystems, Wastewater treatment, Air Pollution Assessment** and **Photovoltaic Systems**. 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.

RENEWABLE ENERGY

Glob Chang Biol (impact factor: 10.8) 1 区 TOP

Vertical Distribution of Rocky Intertidal Organisms Shifts With Sea-Level Variability on the Northeast Pacific Coast.

Kaplanis, Denny, et. al

Abstract:
Disentangling the effects of cyclical variability in environmental forcing and long-term climate change on natural communities is a major challenge for ecologists, managers, and policy makers across ecosystems. Here we examined whether the vertical distribution of rocky intertidal taxa has shifted with sea-level variability occurring at

multiple temporal scales and/or long-term anthropogenic sea-level rise (SLR). Because of the distinct zonation characteristic of intertidal communities, any shift in tidal dynamics or average sea level is expected to have large impacts on community structure and function. We found that across the Northeast Pacific Coast (NPC), sea level exhibits cyclical seasonal variability, tidal amplitude exhibits ecologically significant variability coherent with the 18.6-year periodicity of lunar declination, and long-term sea-level rise is occurring. Intertidal taxa largely do not exhibit significant vertical distribution shifts coherent with short-term (monthly to annual) sea-level variability but do exhibit taxa-specific vertical distribution shifts coherent with cyclical changes in lunar declination and long-term SLR at decadal timescales. Finally, our results show that responses to cyclical celestial mechanics and SLR vary among taxa, primarily according to their vertical distribution. Long-term SLR is occurring on ecologically relevant scales, but the confounding effects of cyclical celestial mechanics make interpreting shifts in zonation or community structure challenging. Such cyclical dynamics alternatingly amplify and dampen long-term SLR impacts and may modify the impacts of other global change related stressors, such as extreme heat waves and swell events, on intertidal organisms living at the edge of their physiological tolerances. As a result, intertidal communities will likely experience cyclical periods of environmental stress and concomitant nonlinear shifts in structure and function as long-term climate change continues. Our results demonstrate that consistent, large-scale monitoring of marine ecosystems is critical for understanding natural variability in communities and documenting long-term change.© 2024 The Author(s). Global Change Biology published by John Wiley & Sons Ltd.

Small Methods (impact factor: 10.7) 2 ☒

Decrypting Synergy of Alloy & Metal Nanoparticles Within Nitrogen-Doped Carbon Nanosheets for Zn-Air Batteries with Ultralong Cycling Stability.

Qing, Liu, et. al

Abstract:

The exploration of efficient, robust, and low-cost bifunctional electrocatalysts to drive the commercial application of Zn-air batteries (ZABs) is of great significance but still remains a challenge. Herein, a 1D coordination polymer (1D-CP) derived FeNi alloy & Co nanoparticles (NPs) co-implanted N-doped carbon nanosheets (FNC/NCS) is judiciously crafted and employed as a high-performance electrocatalyst for ultralong lifetime ZABs. The key to this strategy is the leveraging of metal-coordinated melamine to direct the pyrolysis of 1D-CP, enabling the in situ formation of well-dispersed FeNi alloy and Co NPs within the carbon matrix. The resulting FNC/NCS exhibits prominent oxygen reduction reaction (ORR) and oxygen evolution reaction (OER) activity with a small overall oxygen potential difference (ΔE = 0.68 V). Density functional theory (DFT) simulation demonstrates that the synergistic effect between FeNi alloy and Co NPs can reduce energy barriers, promote electron transfer, and optimize the formation of crucial intermediates, thereby largely boost ORR/OER activity of FNC/NCS. The

FNC/NCS-assembled ZABs possess high specific capacity, large power density, and ultralong cycling life in both aqueous (> 3300 h) and solid-state (150 h) electrolytes. This work provides a viable strategy for 1D-CP-derived bifunctional electrocatalysts and dissects the synergistic effect between different metal species, affording significant guidance for the development of renewable energy materials.© 2024 Wiley‐VCH GmbH.

ChemSusChem (impact factor: 7.5) 2 区 TOP

Advances in Two-Electron Water Oxidation Reaction for Hydrogen Peroxide Production: Catalyst Design and Interface Engineering.

Cao, Chen, et. al

Abstract:

Hydrogen peroxide (H2O2) is a versatile and zero-emission material that is widely used in the industrial, domestic, and healthcare sectors. It is clear that it plays a critical role in advancing environmental sustainability, acting as a green energy source, and protecting human health. Conventional production techniques focused on anthraquinone oxidation, however, electrocatalytic synthesis has arisen as a means of utilizing renewable energy sources in conjunction with available resources like oxygen and water. These strides represent a substantial change toward more environmentally and energy-friendly H2O2 manufacturing techniques that are in line with current environmental and energy goals. This work reviews recent advances in two-electron water oxidation reaction (2e-WOR) electrocatalysts, including design principles and reaction mechanisms, examines catalyst design alternatives and experimental characterization techniques, proposes standardized assessment criteria, investigates the impact of the interfacial milieu on the reaction, and discusses the value of in situ characterization and molecular dynamics simulations as a supplement to traditional experimental techniques and theoretical simulations, as shown in Figure 1. The review also emphasizes the importance of device design, interface, and surface engineering in improving the production of H2O2. Through adjustments to the chemical microenvironment, catalysts can demonstrate improved performance, opening the door for commercial applications that are scalable through tandem cell development.© 2024 The Authors. ChemSusChem published by Wiley-VCH GmbH.

ECOSYSTEMS

J Hazard Mater (impact factor: 12.2) 1 区 TOP

Risk assessment and source tracing of heavy metals in major rice-

producing provinces of Yangtze River Basin.

Ding, Liu, et. al

Abstract:

Heavy metal contamination in rice constitutes a global concern, its migration is influenced by environmental factors as well as socioeconomic activities. However, tracing its origins within complex context remains a significant challenge. The concentrations of five heavy metals (HMs) in 1754 samples from major rice-producing provinces were analyzed, and their pollution characteristics, associated health risks and temporal-spatial variations were discussed. Potential sources were classified by positive matrix factorization (PMF) models, considering correlations with human activities, climatic conditions, and interaction within ecosystems. The results showed that cadmium (Cd) and arsenic (As) were the primary contributors to pollution risk, with the borders between Hunan and central Jiangxi, as well as northeast Jiangxi and northwest Anhui, identified as critical areas for risk management. PMF serves as an effective methodology for identifying the sources of HMs in rice. Industrial activities, particularly mining and transportation, represent the predominant sources of Cd and lead (Pb), accounting for 75.6 % of the total pollution. Conversely, agricultural practices and natural factors constitute the primary sources of As, contributing to the remaining 24.4 %. It is noteworthy that the rapid industrial development has facilitated the expansion of the freight industry, consequently increasing the risk associated with Pb. Furthermore, effective governmental policy management can mitigate the risks related to HMs. Our research highlights the influence of industrial development on HMs risk in various regions and the moderating role of policy formulation. SYNOPSIS: Minimal research exists on the impact of regional economic development on heavy metals in rice. This study reports mining and transportation activities increase carcinogenic risks caused by Cd and Pb in rice during industrialization.Copyright © 2024. Published by Elsevier B.V.

Proc Natl Acad Sci U S A (impact factor: 9.4) 1 区 TOP

Ecological change increases malaria risk in the Brazilian Amazon.

Arisco, Peterka, et al

Abstract:

Ecological change in the Brazilian Amazon is closely linked to human mobility and health. Mining, agriculture, logging, and other activities alter highly diverse ecological and demographic contexts and subsequent exposure to diseases such as malaria. Studies that have attempted to quantify the impact of deforestation on malaria in the Brazilian Amazon have produced conflicting results. However, they varied in methodology and data sources. Most importantly, all studies used annual data, neglecting the subannual seasonal dynamics of malaria. Here, we fill the knowledge gap on the subannual relationship between ecological change in the Brazilian Amazon and malaria transmission. Using the highest spatiotemporal resolution available, we estimated the

effect of deforestation on malaria cases between 2003 and 2022 using a stratified Bayesian spatiotemporal hierarchical zero-inflated Poisson model fitted with the Integrated Nested Laplace Approximation. The model was also stratified by state. We found that a 1% increase in 1-mo lagged deforestation increased malaria cases in a given month and municipality by 6.3% [95% credible interval (Crl): 6.2, 6.5%]. Based on an interaction term included in the model, the effect of deforestation on malaria was even larger in areas with higher forest cover. We found that the coefficients for deforestation and mobility were highly variable when stratified by state. Our results provide detailed evidence that, on average, deforestation increases malaria transmission, but that the relationship is not spatiotemporally uniform. These results have implications for stratifying malaria control interventions based on ecological dynamics to help Brazil achieve its goal of malaria elimination by 2035.

Proc Natl Acad Sci U S A (impact factor: 9.4) 1 区 TOP

Methane fueled lake pelagic food webs in a Cretaceous greenhouse world.

Sun, Luo, et. al

Abstract:

Methane (CH4) is a potent greenhouse gas but also an important carbon and energy substrate for some lake food webs. Understanding how CH4 incorporates into food webs is, therefore, crucial for unraveling CH4 cycling and its impacts on climate and ecosystems. However, CH4-fueled lake food webs from pre-Holocene intervals, particularly during greenhouse climates in Earth history, have received relatively little attention. Here, we present a long-term record of CH4-fueled pelagic food webs across the Cretaceous Oceanic Anoxic Event 1a (~120 Mya) that serves as a geological analog to future warming. We show an exceptionally strong expansion of both methanogens and CH4-oxidizing bacteria (up to 87% of hopanoid-producing bacteria) during this Event. Grazing on CH4-oxidizing bacteria by zooplankton (up to 47% of ciliate diets) within the chemocline transferred substantial CH4-derived carbon to the higher trophic levels, representing an important CH4 sink in the water column. Our findings suggest that as Earth warms, microbial CH4 cycling could restructure food webs and fundamentally alter carbon and energy flows and trophic pathways in lake ecosystems.

WASTEWATER TREATMENT

Adv Mater (impact factor: 27.4) 1 区 TOP

In Situ Molecular Reconfiguration of Pyrene Redox-Active Molecules for High-Performance Aqueous Organic Flow Batteries.

Abstract:
Aqueous organic flow batteries (AOFBs) hold great potential for large-scale energy storage, however, scalable, green, and economical synthetic methods for stable organic redox-active molecules (ORAMs) are still required for their practical applications. Herein, pyrene-based ORAMs are obtained via an in situ organic electrolysis strategy in a flow cell. It is revealed that the water attacking pyrenes restructured molecules to produce a variety of isomers and dimers during the electrolysis, which can be modulated by regulating the local electron cloud density and steric hindrance of pyrene precursors. As a result, the molecularly reconfigured pyrene-based catholytes, even without any further purification, achieved a high electrolyte utilization of ≈96% and volumetric capacity above 50 Ah L-1. Inspiringly, remarkable cell stability with almost no capacity decay for ≈70 days is achieved, benefiting from the robust aromatic structure of the pyrene cores. The insights into the in situ electrosynthesis of pyrene-based ORAMs provided in the work will provide guidance for designing ultra-stable ORAMs for AOFB applications.© 2024 Wiley‐VCH GmbH.

Environ Sci Ecotechnol (impact factor: 14) 1 ☒

High-throughput single-cell sequencing of activated sludge microbiome.

Abstract:
Wastewater treatment plants (WWTPs) represent one of biotechnology's largest and most critical applications, playing a pivotal role in environmental protection and public health. In WWTPs, activated sludge (AS) plays a major role in removing contaminants and pathogens from wastewater. While metagenomics has advanced our understanding of microbial communities, it still faces challenges in revealing the genomic heterogeneity of cells, uncovering the microbial dark matter, and establishing precise links between genetic elements and their host cells as a bulk method. These issues could be largely resolved by single-cell sequencing, which can offer unprecedented resolution to show the unique genetic information. Here we show the high-throughput single-cell sequencing to the AS microbiome. The single-amplified genomes (SAGs) of 15,110 individual cells were clustered into 2,454 SAG bins. We find that 27.5% of the genomes in the AS microbial community represent potential novel species, highlighting the presence of microbial dark matter. Furthermore, we identified 1,137 antibiotic resistance genes (ARGs), 10,450 plasmid fragments, and 1,343 phage contigs, with shared plasmid and phage groups broadly distributed among hosts, indicating a high frequency of horizontal gene transfer (HGT) within the AS microbiome. Complementary analysis using 1,529 metagenome-assembled genomes from the AS samples allowed for the taxonomic classification of 98 SAG bins, which were previously unclassified. Our study establishes the feasibility of single-cell sequencing

in characterizing the AS microbiome, providing novel insights into its ecological dynamics, and deepening our understanding of HGT processes, particularly those involving ARGs. Additionally, this valuable tool could monitor the distribution, spread, and pathogenic hosts of ARGs both within AS environments and between AS and other environments, which will ultimately contribute to developing a health risk evaluation system for diverse environments within a One Health framework.© 2024 The Authors.

J Hazard Mater (impact factor: 12.2) 1 区 TOP

Differential inhibition of tire wear particles on sludge dewatering by aging modes.

Li, Chen, et. al

Abstract:

The study assessed the acute toxicities of tire wear particles (TWPs) on activated sludge, comparing cryogenically ground TWPs (C-TWPs) with photo-aged (PA-TWPs), ozone-aged (OA-TWPs), and Fenton-aged (FA-TWPs) variants over 96 h. At 0.1 mg/L, TWPs showed no significant effects on sludge respiration or purification. However, at 50 mg/L, significant impacts on respiration, decontamination capacity, and microbial community structure were observed, particularly in aged TWPs. Specifically, aged TWPs, especially FA-TWPs, are prone to inducing necrosis by generating non-cellular reactive oxygen species (ROS) catalyzed by persistent free radicals, leading to an increase in lactate dehydrogenase release ranging from 215 % to 284 %. Conversely, C-TWPs tend to trigger apoptosis via intracellular ROS accumulation, leading to a 358 % increase in intracellular ROS. Aged TWPs exhibited higher affinities for proteins and polysaccharides, while C-TWPs preferred phospholipids. All TWPs adversely affected sludge dewatering, with strong correlations found between specific resistance to filtration (SRF) and total protein ($r = 0.981$, $p < 0.001$) and between bound water and early cell apoptosis ($r = 0.961$, $p < 0.01$). Additionally, a correlation between SRF and cellular necrosis ($r = 0.956$, $p < 0.01$) was noted, linked to increased protein and extracellular polymeric substance levels. These results emphasize substantial influence of aged TWPs on sludge dewatering efficiency via diverse bacterial cell death mechanisms.Copyright © 2024 Elsevier B.V. All rights reserved.

AIR POLLUTION ASSESSMENT

Environ Int (impact factor: 10.3) 1 区 TOP

Impact of net zero policy scenarios on air pollution inequalities in England and Wales.

Abstract

The UK is committed to achieve net zero greenhouse gas emissions by 2050. The suite of policies needed to reach net zero will lead to improvements in air quality and, consequently, could lessen air pollution inequalities. We assessed air pollution inequalities across different sociodemographic groups in England and Wales and explored how these might be differentially impacted by future air pollution projections in 2030 and 2040 under net zero policies.We employed a geodemographic classification approach to categorise neighbourhoods into five distinct clusters based on 2021 UK Census sociodemographic variables. We modelled fine particulate matter (PM2.5) and nitrogen dioxide (NO2) concentrations for the year 2019, and predicted concentrations in 2030 and 2040. We compared a business-as-usual (BAU) scenario and two policy pathways to achieve net zero currently considered by the UK government. We aggregated air pollution concentrations to the neighbourhood level and assessed differential neighbourhood-level concentrations across the geodemographic groups using descriptive statistics and box plots.The Urban Central Professionals group experienced 14 µg/m3 higher average NO2 concentrations compared with the Rural Elderly group in 2019. Despite substantial improvements to air quality in 2030 and 2040 of up to 6.3 µg/m3 for NO2 based on BAU, and further reductions of up to 2.4 µg/m3 NO2 under net zero policies, the overall pattern of inequality persists, but is predicted to be less pronounced.Our findings demonstrate the effectiveness of targeted policies and innovations in reducing both air quality and greenhouse gas emissions and in bridging the environmental inequality gap. Our findings are essential to develop targeted communication campaigns to secure acceptance and willingness across the sociodemographic spectrum to support the significant behavioural changes needed to achieve net zero, by highlighting the wider co-benefits to the environment and health of such policies.Copyright © 2024 The Author(s). Published by Elsevier Ltd.. All rights reserved.

Environ Int (impact factor: 10.3) 1 区 TOP

Munich's selective diesel vehicle ban and its impact on nitrogen dioxide concentrations: A quasi-experimental study.

Leibinger, Rehfuess, et. al

Abstract

The current limit on NO2 concentrations of 40 µg/m3, set by the European Union, has been regularly exceeded in Munich, Germany. This limit will likely be reduced towards the WHO recommended target of 10 µg/m3. Against this backdrop, the city implemented a selective diesel vehicle ban within the existing low-emission zone in February 2023, targeting Euro 4 and older diesel vehicles. Our study investigated the

effect of Munich's selective diesel vehicle ban on NO2 concentrations, focusing on the half-year period following its implementation.Our study utilized a synthetic control approach (primary analysis) and a controlled interrupted time series approach (secondary analysis). These quasi-experimental methodologies create a 'counterfactual' no-intervention scenario, enabling comparison between observed and counterfactual scenarios to estimate an intervention effect. We employed historical controls, using routine data from multiple monitoring stations located within and outside the low-emission zone for 2014 to 2022, and considered possible confounders.NO2 concentrations within Munich's low-emission zone showed overall declining trends from August 2014 to July 2023. Effects of the selective diesel vehicle ban were small and wide confidence intervals indicate large uncertainty in the magnitude and direction of the effect. At Landshuter Allee, the average intervention effect was -2.67 µg/m3 (95 %-CI = [-12.72; 7.38]), at Stachus it was -2.74 µg/m3 (95 %-CI = [-9.91; 4.42]), and at Lothstrasse it was -1.03 µg/m3 (95 %-CI = [-7.75; 5.69]). The secondary analysis confirmed these findings, reinforcing uncertainty about the effect of the intervention.Our study suggests that Munich's selective diesel vehicle ban had a limited effect on lowering NO2 concentrations. Possible explanations include the ban's focus on Euro 4 and older diesel vehicles, many exemptions to the selective ban, and unclear enforcement. This highlights that comprehensive approaches and ongoing, well-designed monitoring and evaluation are crucial for addressing urban air pollution and protecting public health.Copyright © 2024 The Authors. Published by Elsevier Ltd.. All rights reserved.

Sci Total Environ (impact factor: 8.2) 1 区 TOP

Large eddy simulation of the dispersion of short duration emissions: Implications for the metrological evaluation of remote sensing devices for on-road emissions monitoring.

Domínguez-Sáez, Urgorri, et. al

Abstract

Remote sensing techniques have emerged as valuable tools for characterizing pollutant emissions from large vehicle fleets and identifying high emitter single vehicles in real driving conditions. Nevertheless, the use of these systems for official emission control purposes by public administrations is an issue because the remote sensing devices must obtain official metrological certification, which currently lacks an international technical standard. The fluid dynamic study that we present demonstrates the promising potential of using pulsed synthetic reference plumes of known chemical composition in order to simulate exhaust emissions produced by combustion engine vehicles in a repetitive and controlled way. This scheme would facilitate the implementation of these complex metrological certification tests and drastically reduce the potential costs associated to these certifications and the emission of gases. In this paper, the atmospheric dispersion of the synthetic puff-like plumes after being released from a vehicle has been studied through fluid dynamic simulations, in order to identify their

optimal usage conditions as reference materials. The simulations have allowed to study the evolution of two types of reference short plumes (puffs generated at 2 and 6 bars) from a vehicle at static and dynamic conditions. Results show that, in spite of the fast dispersion of these puffs, it is possible to accurately determine their chemical composition by optical techniques, for instance, by differential absorption spectroscopy. This opens the way for designing advanced and robust metrological evaluation procedures that could be the basis of a future technical standard for the certification of optical remote sensors of traffic emissions. This would allow future deployment of those certificated remote sensors on roads, contributing to a sustainable mobility and effective air pollution management strategies.Copyright © 2024. Published by Elsevier B.V.

PHOTOVOLTAIC SYSTEMS

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

Formamidinium Incorporates into Rb-based Non-perovskite Phases in Solar Cell Formulations.

Gunes, Hope, et. al

Abstract

Organic-inorganic hybrid perovskite materials, such as formamidinium lead iodide (FAPbI3), are among the most promising emerging photovoltaic materials. However, the spontaneous phase transition from the photoactive perovskite phase to an inactive non-perovskite phase complicates the application of FAPbI3 in solar cells. To remedy this, alkali metal cations, most often Cs+, Rb+or K+, are included during perovskite synthesis to stabilize the photoactive phase. The atomic-level mechanisms of stabilization are complex. While Cs+ dopes directly into the perovskite lattice, Rb+ does not, but instead forms an additional non-perovskite phase, and the mechanism by which Rb confers increased stability remains unclear. Here, we use 1H-87Rb double resonance NMR experiments to show that FA+ incorporates into the Rb-based non-perovskite phases (FAyRb1-yPb2Br5 and δ-FAyRb1-yPbI3) for both bromide and iodide perovskite formulations. This is demonstrated by changes in the 1H and 87Rb chemical shifts, 1H-87Rb heteronuclear correlation spectra, and 87Rb{1H} REDOR spectra. Simulation of the REDOR dephasing curves suggests up to ~60% FA+ incorporation into the inorganic Rb-based phase for the bromide system. In light of these results, we hypothesize that the substitution of FA+ into the non-perovskite phase may contribute to the greater stability conferred by Rb salts in the synthesis of FA-based perovskites.© 2024 Wiley‐VCH GmbH.

Sci Total Environ (impact factor: 8.2) 1 区 TOP

Locating the suitable large-scale solar farms in China's deserts with environmental considerations.

Wang, Liu, et. al

Abstract:

Desert areas offer rich solar resources and low land use costs, ideal for large-scale new energy development. However, desert ecosystems are fragile, and large-scale photovoltaic (PV) power facilities pose ecological risks. Current assessments of PV plant sites in deserts lack consideration of wind-sand hazards and ecological impacts. In this study, we have developed a new large-scale photovoltaic (PV) site selection model that integrates the analytic hierarchy process with geographic information system technology, and applies it to the desert regions of China. The results show that the potential for large-scale PV power plants in China's deserts is significant, with 69.4 % of the region assessed as medium or higher. The most suitable area is 12.7 × 104 km2 (7.6 % of the overall study area), mainly centered in the Tibetan Plateau's Qaidam Basin Desert and the deserts of northern China, characterized by favorable solar resources, climate, and terrain. Across all regions, gravel deserts are recognized as more suitable for the construction of large-scale PV power projects than sandy deserts. Considering varying PV installation density scenarios with an installed capacity potential of 36.4-84.9 TW and system costs ranging from 10.0 to 33.5 trillion USD, the study estimates an annual solar power generation potential of 47-110 PWh which is 1.7-3.9 times the global electricity demand. Carbon emissions could be reduced by 26.8-62.6 gigatons annually, offsetting 73-170 % of global emissions. Covering just 4.8-11.5 % of China's desert area (8 × 104-19.4 × 104 km2) would meet the projected 2025 electricity needs of the country. This study lays the groundwork for spatial planning and benefit assessment of large-scale PV projects in desert regions, and reduces conflicts between PV plant construction and local ecosystem.Copyright © 2024. Published by Elsevier B.V.

ACS Photonics (impact factor: 6.5) 1 区 TOP

Locally Phase-Engineered MoTe2 for Near-Infrared Photodetectors.

Hidding, Cordero-Silis, et. al

Abstract:

Transition-metal dichalcogenides (TMDs) are ideal systems for two-dimensional (2D) optoelectronic applications owing to their strong light-matter interaction and various band gap energies. New techniques to modify the crystallographic phase of TMDs have recently been discovered, allowing the creation of lateral heterostructures and the design of all-2D circuitry. Thus, far, the potential benefits of phase-engineered TMD devices for optoelectronic applications are still largely unexplored. The dominant mechanisms involved in photocurrent generation in these systems remain unclear,

hindering further development of new all-2D optoelectronic devices. Here, we fabricate locally phase-engineered MoTe2 optoelectronic devices, creating a metal (1T') semiconductor (2H) lateral junction and unveil the main mechanisms at play for photocurrent generation. We find that the photocurrent originates from the 1T'-2H junction, with a maximum at the 2H MoTe2 side of the junction. This observation, together with the nonlinear IV-curve, indicates that the photovoltaic effect plays a major role in the photon-to-charge current conversion in these systems. Additionally, the 1T'-2H MoTe2 heterojunction device exhibits a fast optoelectronic response over a wavelength range of 700-1100 nm, with a rise and fall times of 113 and 110 μs, respectively, 2 orders of magnitude faster when compared to a directly contacted 2H MoTe2 device. These results show the potential of local phase-engineering for all-2D optoelectronic circuitry.© 2024 The Authors. Published by American Chemical Society.

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Ⅱ Concentration

PHYSICS

Direct optical measurement of intramolecular distances with angstrom precision

Steffen J. Sahl, Jessica Matthias, Kaushik Inamdar, et al.

Abstract

Optical investigations of nanometer distances between proteins, their subunits, or other biomolecules have been the exclusive prerogative of Förster resonance energy transfer (FRET) microscopy for decades. In this work, we show that MINFLUX fluorescence nanoscopy measures intramolecular distances down to 1 nanometer—and in planar projections down to 1 angstrom—directly, linearly, and with angstrom precision. Our method was validated by quantifying well-characterized 1- to 10-nanometer distances in polypeptides and proteins. Moreover, we visualized the orientations of immunoglobulin subunits, applied the method in human cells, and revealed specific configurations of a histidine kinase PAS domain dimer. Our results open the door for examining proximities and interactions by direct position measurements at the intramacromolecular scale.

Multi-qubit gates and Schrödinger cat states in an optical clock

Cao, Alec, Eckner, et al.

Abstract

Many-particle entanglement is a key resource for achieving the fundamental precision limits of a quantum sensor[1]. Optical atomic clocks[2], the current state of the art in frequency precision, are a rapidly emerging area of focus for entanglement-enhanced metrology[3,4,5,6]. Augmenting tweezer-based clocks featuring microscopic control and detection[7,8,9,10] with the high-fidelity entangling gates developed for atom-array information processing[11,12] offers a promising route towards making use of highly entangled quantum states for improved optical clocks. Here we develop and use a family of multi-qubit Rydberg gates to generate Schrödinger cat states of the Greenberger–Horne–Zeilinger (GHZ) type with up to nine optical clock qubits in a programmable atom array. In an atom-laser comparison at sufficiently short dark times, we demonstrate a fractional frequency instability below the standard quantum limit (SQL) using GHZ states of up to four qubits. However, because of their reduced dynamic range, GHZ states of a single size fail to improve the achievable clock precision at the optimal dark time compared with unentangled atoms[13]. Towards

overcoming this hurdle, we simultaneously prepare a cascade of varying-size GHZ states to perform unambiguous phase estimation over an extended interval[14,15,16,17]. These results demonstrate key building blocks for approaching Heisenberg-limited scaling of optical atomic clock precision.

Universal quantum operations and ancilla-based read-out for tweezer clocks

Finkelstein, Ran, et al.

Abstract

Enhancing the precision of measurements by harnessing entanglement is a long-sought goal in quantum metrology[1,2]. Yet attaining the best sensitivity allowed by quantum theory in the presence of noise is an outstanding challenge, requiring optimal probe-state generation and read-out strategies[3,4,5,6,7]. Neutral-atom optical clocks[8], which are the leading systems for measuring time, have shown recent progress in terms of entanglement generation[9,10,11] but at present lack the control capabilities for realizing such schemes. Here we show universal quantum operations and ancilla-based read-out for ultranarrow optical transitions of neutral atoms. Our demonstration in a tweezer clock platform[9,12,13,14,15,16] enables a circuit-based approach to quantum metrology with neutral-atom optical clocks. To this end, we demonstrate two-qubit entangling gates with 99.62(3)% fidelity—averaged over symmetric input states—through Rydberg interactions[15,17,18] and dynamical connectivity[19] for optical clock qubits, which we combine with local addressing[16] to implement universally programmable quantum circuits. Using this approach, we generate a near-optimal entangled probe state[1,4], a cascade of Greenberger–Horne–Zeilinger states of different sizes, and perform a dual-quadrature[5] Greenberger–Horne–Zeilinger read-out. We also show repeated fast phase detection with non-destructive conditional reset of clock qubits and minimal dead time between repetitions by implementing ancilla-based quantum logic spectroscopy[20] for neutral atoms. Finally, we extend this to multi-qubit parity checks and measurement-based, heralded, Bell-state preparation[21,22,23,24]. Our work lays the foundation for hybrid processor–clock devices with neutral atoms and more generally points to a future of practical applications for quantum processors linked with quantum sensors[25].

MATERIALS

Long-term stability in perovskite solar cells through atomic layer deposition of tin oxide

Abstract

Robust contact schemes that boost stability and simplify the production process are needed for perovskite solar cells (PSCs). We codeposited perovskite and hole-selective contact while protecting the perovskite to enable deposition of SnOx/Ag without the use of a fullerene. The SnOx, prepared through atomic layer deposition, serves as a durable inorganic electron transport layer. Tailoring the oxygen vacancy defects in the SnOx layer led to power conversion efficiencies (PCEs) of >25%. Our devices exhibit superior stability over conventional p-i-n PSCs, successfully meeting several benchmark stability tests. They retained >95% PCE after 2000 hours of continuous operation at their maximum power point under simulated AM1.5 illumination at 65°C. Additionally, they boast a certified T97 lifetime exceeding 1000 hours.

Grain rotation mechanisms in nanocrystalline materials: Multiscale observations in Pt thin films

Yuan Tian, Xiaoguo Gong, et al.

Abstract

Near-rigid-body grain rotation is commonly observed during grain growth, recrystallization, and plastic deformation in nanocrystalline materials. Despite decades of research, the dominant mechanisms underlying grain rotation remain enigmatic. We present direct evidence that grain rotation occurs through the motion of disconnections (line defects with step and dislocation character) along grain boundaries in platinum thin films. State-of-the-art in situ four-dimensional scanning transmission electron microscopy (4D-STEM) observations reveal the statistical correlation between grain rotation and grain growth or shrinkage. This correlation arises from shear-coupled grain boundary migration, which occurs through the motion of disconnections, as demonstrated by in situ high-angle annular dark-field STEM observations and the atomistic simulation–aided analysis. These findings provide quantitative insights into the structural dynamics of nanocrystalline materials.

Opto-twistronic Hall effect in a three-dimensional spiral lattice

Ji, Zhurun, Zhao, et al.

Abstract

Studies of moiré systems have explained the effect of superlattice modulations on their properties, demonstrating new correlated phases[1]. However, most experimental studies have focused on a few layers in two-dimensional systems. Extending twistronics to three dimensions, in which the twist extends into the third dimension, remains

underexplored because of the challenges associated with the manual stacking of layers. Here we study three-dimensional twistronics using a self-assembled twisted spiral superlattice of multilayered WS_2. Our findings show an opto-twistronic Hall effect driven by structural chirality and coherence length, modulated by the moiré potential of the spiral superlattice. This is an experimental manifestation of the noncommutative geometry of the system. We observe enhanced light–matter interactions and an altered dependence of the Hall coefficient on photon momentum. Our model suggests contributions from higher-order quantum geometric quantities to this observation, providing opportunities for designing quantum-materials-based optoelectronic lattices with large nonlinearities.

CHEMISTRY

Catalytic prenyl conjugate additions for synthesis of enantiomerically enriched PPAPs

Shawn Ng, Casey Howshall, et. al

Abstract

Polycyclic polyprenylated acylphloroglucinols (PPAPs) are a class of >400 natural products with a broad spectrum of bioactivity, ranging from antidepressant and antimicrobial to anti-obesity and anticancer activity. Here, we present a scalable, regio-, site-, and enantioselective catalytic method for synthesis of cyclic β-prenyl ketones, compounds that can be used for efficient syntheses of many PPAPs in high enantiomeric purity. The transformation is prenyl conjugate addition to cyclic β-ketoesters promoted by a readily accessible chiral copper catalyst and involving an easy-to-prepare and isolable organoborate reagent. Reactions reach completion in just a few minutes at room temperature. The importance of this advance is highlighted by the enantioselective preparation of intermediates previously used to generate racemic PPAPs. We also present the enantioselective synthesis of nemorosonol (14 steps, 20% yield) and its one-step conversion to another PPAP, garcibracteatone (52% yield).

Synthesis of non-canonical amino acids through dehydrogenative tailoring

Gu, Xin, et. al

Abstract

Amino acids are essential building blocks in biology and chemistry. Whereas nature relies on a small number of amino acid structures, chemists desire access to a vast range

of structurally diverse analogues[1,2,3]. The selective modification of amino acid side-chain residues represents an efficient strategy to access non-canonical derivatives of value in chemistry and biology. While semisynthetic methods leveraging the functional groups found in polar and aromatic amino acids have been extensively explored, highly selective and general approaches to transform unactivated C–H bonds in aliphatic amino acids remain less developed[4,5]. Here we disclose a stepwise dehydrogenative method to convert aliphatic amino acids into structurally diverse analogues. The key to the success of this approach lies in the development of a selective catalytic acceptorless dehydrogenation method driven by photochemical irradiation, which provides access to terminal alkene intermediates for downstream functionalization. Overall, this strategy enables the rapid synthesis of new amino acid building blocks and suggests possibilities for the late-stage modification of more complex oligopeptides.

Direct evidence for a carbon–carbon one-electron σ-bond

Shimajiri, Takuya, et. al

Abstract

Covalent bonds share electron pairs between two atoms and make up the skeletons of most organic compounds in single, double and triple bonds. In contrast, examples of one-electron bonds remain scarce, most probably due to their intrinsic weakness[1,2,3,4]. Although several pioneering studies have reported one-electron bonds between heteroatoms, direct evidence for one-electron bonds between carbon atoms remains elusive. Here we report the isolation of a compound with a one-electron σ-bond between carbon atoms by means of the one-electron oxidation of a hydrocarbon with an elongated C–C single bond[5,6]. The presence of the C•C one-electron σ-bond (2.921(3) Å at 100 K) was confirmed experimentally by single-crystal X-ray diffraction analysis and Raman spectroscopy, and theoretically by density functional theory calculations. The results of this paper unequivocally demonstrate the existence of a C•C one-electron σ-bond, which was postulated nearly a century ago[7], and can thus be expected to pave the way for further development in different areas of chemistry by probing the boundary between bonded and non-bonded states.

BIOLOGY

Temporal variability and cell mechanics control robustness in mammalian embryogenesis

Dimitri Fabrèges, Bernat Corominas-Murtra, et al.

Abstract

How living systems achieve precision in form and function despite their intrinsic stochasticity is a fundamental yet ongoing question in biology. We generated morphomaps of preimplantation embryogenesis in mouse, rabbit, and monkey embryos, and these morphomaps revealed that although blastomere divisions desynchronized passively, 8-cell embryos converged toward robust three-dimensional shapes. Using topological analysis and genetic perturbations, we found that embryos progressively changed their cellular connectivity to a preferred topology, which could be predicted by a physical model in which actomyosin contractility and noise facilitate topological transitions, lowering surface energy. This mechanism favored regular embryo packing and promoted a higher number of inner cells in the 16-cell embryo. Synchronized division reduced embryo packing and generated substantially more misallocated cells and fewer inner-cell–mass cells. These findings suggest that stochasticity in division timing contributes to robust patterning.

Epigenetic regulators of clonal hematopoiesis control CD8 T cell stemness during immunotherapy

Tae Gun Kang, Xin Lan, et. al

Abstract

Epigenetic reinforcement of T cell exhaustion is known to be a major barrier limiting T cell responses during immunotherapy. However, the core epigenetic regulators restricting antitumor immunity during prolonged antigen exposure are not clear. We investigated three commonly mutated epigenetic regulators that promote clonal hematopoiesis to determine whether they affect T cell stemness and response to checkpoint blockade immunotherapy. CD8 T cells lacking Dnmt3a, Tet2, or Asxl1 preserved a progenitor-exhausted (Tpex) population for more than 1 year during chronic antigen exposure without undergoing malignant transformation. Asxl1 controlled the self-renewal capacity of T cells and reduced CD8 T cell differentiation through H2AK119 ubiquitination and epigenetic modification of the polycomb group–repressive deubiquitinase pathway. Asxl1-deficient T cells synergized with anti–PD-L1 immunotherapy to improve tumor control in experimental models and conferred a survival advantage to mutated T cells from treated patients.

Predicting pathogen mutual invasibility and co-circulation

Sang Woo Park, Sarah Cobey, et. al

Abstract

Observations of pathogen community structure provide evidence for both the coexistence and replacement of related strains. Despite many studies of specific host-pathogen systems, a unifying framework for predicting the outcomes of interactions among pathogens has remained elusive. We address this gap by developing a pathogen invasion theory (PIT) based on modern ecological coexistence theory and testing the resulting framework against empirical systems. Across major human pathogens, PIT predicts near-universal mutual susceptibility of one strain to invasion by another strain. However, predicting co-circulation from mutual invasion also depends on the degree to which susceptible abundance is reduced below the invasion threshold by overcompensatory epidemic dynamics, and the time it takes for susceptibles to replenish. The transmission advantage of an invading strain and the strength and duration of immunity are key determinants of susceptible dynamics. PIT unifies existing ideas about pathogen co-circulation, offering a quantitative framework for predicting the emergence of novel pathogen strains.

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Ⅲ Calling for papers

ICRET 2025 (EI)

Submission deadline: **Nov 10, 2024**
Conference date: **Mar 21, 2025 - Mar 23, 2025**
Full name: **The 11th International Conference On Renewable Energy Technologies**
Location: **Chongqing, China**

Welcome To The Official Website Of 2025 The 11th International Conference On Renewable Energy Technologies (ICRET 2025). The Conference Will Be Held In Chongqing, China During March 21-23, 2025.
It Focuses On Timely And Emerging Topics Of Interest To The Renewable Energy Technologies That Provides An Opportunity For In-Depth Exchange Of Research Ideas In An Informal Environment. To Encourage Discussion And Dissemination Of The Latest Research Developments, Early-Stage Work, And Possibly Controversial Results, Workshops, The Conference Will Bring Together Leading Researchers, Engineers And Scientists In The Domain Of Interest From Around The World. We Contribute To Be The Premier And Most Selective Conference And Devote To Technical Innovations In Renewable Energy Technologies.

Call for papers:

TOPIC A
Clean and Renewable Energy

▶ Energy-Saving Technology
▶ New Energy Applications
▶ New Energy Materials and Devices
▶ Photovoltaic Systems and Solar Energy Engineering
▶ Renewable Energy Utilizations
▶ Wind Energy Systems

TOPIC B
Power and Energy Engineering

▶ Electricity Networks of the Future
▶ Energy Storage Technologies and Devices
▶ Power and Energy Generation
▶ Energy Transmission and Distribution
▶ Power Systems and Automation
▶ Fault monitoring and Predictive Maintenance

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ICEES 2025 (SPRINGER)

Submission deadline: **Nov 10, 2024**
Conference date: **Mar 21, 2025 - Mar 23, 2025**
Full name: **the 9th International Conference on Energy and Environmental Science**
Location: **Chongqing, China**

Welcome to the official website of 2025 the 9th International Conference on Energy and Environmental Science (ICEES 2025) to be held in Chongqing, China during March 21-23 . ICEES2025 will be sponsored by Chongqing Jiaotong University, China and Chongqing University, China.

ICEES is an annual conference which aims to present the latest research and results of scientists (professors, doctoral students, and post-doc scientists) related to Energy and Environmental Science topics. This conference provides opportunities for delegates from different areas to exchange new ideas, applications and experiences face to face, to establish business or research relations, and to find global partners for future collaboration. We hope that the conference results in significant contributions to the knowledge base in these scientific fields.

ICEES features invited keynote speeches, peer-reviewed paper presentations, and academic visit. The conference is completely open (one needs to register first), you will not have to be an author or a discussant to attend. With the successful experience of the last five 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, we will see that ICEES 2025 will come back to China to achieve another success and provide a better platform for all the participants to have fruitful discussions and to share ideas of researches.

Topics of Interest :

-Sustainable/Renewable Energy
*Biofuels / Biofuel Cells
*Hybrid Energy Systems
-Alternative Energy and the Environment
*Energy Conservation
*Energy Conversion
-Management of Ecosystems, Environment and Water Resources
*Ecosystems Management
*Solid Waste Management
-Assessments of the Condition of Ecosystems and Environmental Quality
*Air Quality Assessment
*Ecosystems Assessment
-Modelling and Regional Environmental Assessments (Includes Global Change)
*Modeling
*Environmental Process Simulation-
-Behaviour of and Impacts of Pollutants in Atmosphere, Soil and Water
* Transport of Air Pollutants
*Metal Behaviour: Distribution, Speciation and Bioavailability
-Treatment/ Restoration of Ecosystems, Environment and Water resources
* Wastewater and Sludge Treatment
*Drinking Water treatment

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ICRCE 2025 (SPRINGER)

Submission deadline: **Nov 10, 2024**
Conference date: **Feb 15, 2025 - Feb 17, 2025**
Full name: **15th International Conference on Renewable and Clean Energy**
Location: **Fukuoka, Japan**

2025 15th International Conference on Renewable and Clean Energy (ICRCE 2025) is going to take place in Fukuoka, Japan during February 15-17, 2025, supported by Toyota Technological Institute, Japan. It will offer an ideal platform for presentation, discussion, criticism and exchange of innovative ideas and current challenges in the field of renewable and clean energy.
The main theme of the conference is to address and deliberate on the latest technical status and recent trends in the research and applications of renewable and clean energy. The purpose of the conference is to provide an opportunity for the scientists, engineers, industrialists, scholars and other professionals from all over the world to interact and exchange their new ideas and research outcomes in related fields and develop possible chances for future collaboration. The conference is also aimed at motivating the next generation of researchers to promote their interests in renewable and clean energy.

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

Renewable (Green) Energy Systems and Sources (RESSs) as Wind Power, Hydropower, Solar Energy, Biomass, Biofuel, Geothermal Energy, Wave Energy, Tidal energy, Hydrogen & Fuel Cells, Energy Storage
New Trends and Technologies for RESSs
Policies and Strategies for RESSs
Energy Transformation from Renewable Energy System (RES) to Grid
Novel Energy Conversion Studies for RESs
Power Devices and Driving Circuits for RESs
Control Techniques for RESs
Grid Interactive Systems Used in Hybrid RESs
Performance Analysis of RESs
Hybrid RESSs
Decision Support Systems for RESSs
Renewable Energy Research and Applications for Industries
RESSs for Electrical Vehicles and Components
Artificial Intelligence and Machine Learning Studies for RESs and Applications
Computational Methods for RESSs
Energy Savings for Vehicular Technology, Power Electronics, Electric Machinery and Control, etc.
New Approaches in Lightings
Public Awareness and Education for Renewable Energy and Systems
Reliability and Maintenance in RESSs
Smart grids and RESSs
Safety and Security of RESSs
Renewable Energy Systems in Smart Cities
Future Challenges and Directions for RESS

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ICGDA 2025(EI)

Submission deadline: **Nov 15, 2024**
Conference date: **Apr 4, 2025 - Apr 6, 2025**
Full name: **8th International Conference on Geoinformatics and Data Analysis**
Location: **Nice, France**

ICGDA2025 is Co-sponsored by Ecole Centrale de Marseille, Aix Marseille University, France, and Palacky University, Czech Republic. The theme for the conference is "Geoinformatics and Data Analysis". On behalf of the organizing committee, we are pleased to announce that the 2025 8th International Conference on Geoinformatics and Data Analysis (ICGDA 2025) will be held from April 4 to 6, 2025 in Nice, France. The First two ICGDA conferences were held in Prague, Czech Republic successfully and ICGDA2020-2022 conferences were held as online form because of COVID-19 and travel restrictions. ICGDA 2023 was held as a hybrid conference after COVID-19 and the physical conference was taken place in Faculté de Saint Jérôme, Aix Marseille Université. ICGDA2024 was held in Paris in person during April 19 to 21 successively.

***Call for papers:**
Acquisition and processing of remotely sensed data
Analysis-oriented and standards-compliant WebGIS
Applications of BeiDou navigation satellite system
Automated object extraction and database updates from imagery
Big Data analytics
Cartographic theory and applications
Climate changes and global environment
Cyberinfrastructure and CyberGIS
Data models in cartography
Digital gazetteer
Environmental criminology and crime simulation
Environmental hazards and natural disasters
Environmental health, disease, and wellbeing
LIDAR technology for DEM generation and 3D modeling
Land use and land cover change
Map generalization
Mobile data collection, management and analysis
Monitoring of resources and environment
Multi-dimensional (2D, 3D, and 4D) spatial data modeling and data quality
New trends of technologies and research in GIS
Processing and application of high-resolution imagery
Representation and visualization of geospatial data
Satellite positioning technology and location based service
Semantic web and sensor web
Smart city and sustainable development
Space-time integration

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ICBMC 2025(SPRINGER)

Submission deadline: **Nov 20, 2024**
Conference date: **Feb 21, 2025 - Feb 24, 2025**
Full name: **10th International Conference on Building Materials and Construction**
Location: **Okinawa, Japan**

Building material is any material which is used for construction purposes. Many naturally occurring substances, such as clay, rocks, sand, and wood, even twigs and leaves, have been used to construct buildings. Apart from naturally occurring materials, many man-made products are in use, some more and some less synthetic. The manufacture of building materials is an established industry in many countries and the use of these materials is typically segmented into specific specialty trades, such as carpentry, insulation, plumbing, and roofing work. They provide the make-up of habitats and structures including homes.
The primary goal of ICBMC 2025 is to promote research and developmental activities in Building Materials and Construction. Another goal is to promote scientific information interchange between researchers, developers, engineers, students, and practitioners working in Singapore and abroad. The conference will be held every year to make it an ideal platform for people to share views and experiences in Building Materials and Construction and related areas.

Topics of interest

☆ Architecture and Urban Planning
Architectural Design and Theories
Advanced Construction Materials
Aesthetics and Landscape
Architectural Design and Its Theory
☆ Materials Science and Engineering
Metallic Alloys, Tool Materials
Superplastic Materials
Ceramics and Glasses
Composites
☆ Civil and Structural Engineering
Bridge Engineering;Building Structure and Bridge Engineering;
Building Technology;Cartography and Geographic Information System;
Coastal Engineering;Computational Mechanics;
Computer Simulation and CAD/CAE;Concrete Structures;
☆ Materials Properties, Measuring Methods & Applications
Ductility, Crack Resistance, Fatigue, Creep-resistance
Fracture Mechanics, Mechanical Properties
Electrical Properties, and Magnetic Properties
Corrosion, Erosion, Wear Resistance
☆ Materials Manufacturing and Processing
Casting, Powder Metallurgy
Welding, Sintering, Heat Treatment
Thermo-Chemical Treatment
Thin & Thick Coatings

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