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/2018/1015/c5474a113860/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 in researches on Environmental Engineering. The papers are classified in 5 categories, and they are: **Renewable Energy, Soil Pollution and Treatment, Wastewater Treatment, Global Warming** and **Ecosystems**. 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

Chem Rev (impact factor: 62.1) 1 区 TOP

Production of Renewable Hydrocarbon Biofuels with Lignocellulose and Its Derivatives over Heterogeneous Catalysts.

Li, Wang, et. al

Abstract:
In recent years, the issues of global warming and CO2 emission reduction have garnered increasing global attention. In the 21st Conference of the Parties (convened in Paris in 2015), 179 nations and the European Union signed a pivotal agreement to limit the global temperature increase of this century to well below 2 K above preindustrial

levels. To fulfill this objective, extensive research has been conducted to use renewable energy sources as potential replacements for traditional fossil fuels. Among them, the production of hydrocarbon transportation fuels from CO2-neutral and renewable biomass has proven to be a particularly promising solution due to its compatibility with existing infrastructure. This review systematically summarizes research progress in the synthesis of liquid hydrocarbon biofuels from lignocellulose during the past two decades. Based on the chemical structure (including n-paraffins, iso-paraffins, aromatics, and cycloalkanes) of hydrocarbon transportation fuels, the synthesis pathways of these biofuels are discussed in four separate sections. Furthermore, this review proposes three guiding principles for the design of practical hydrocarbon biofuels, providing insights into future directions for the development of viable biomass-derived liquid fuels.

Adv Mater (impact factor: 29.4) 1 ☒ TOP

From Charge to Spin: An In-Depth Exploration of Electron Transfer in Energy Electrocatalysis.

Sun, Zhang, et. al

Abstract:
Catalytic materials play crucial roles in various energy-related processes, ranging from large-scale chemical production to advancements in renewable energy technologies. Despite a century of dedicated research, major enduring challenges associated with enhancing catalyst efficiency and durability, particularly in green energy-related electrochemical reactions, remain. Focusing only on either the crystal structure or electronic structure of a catalyst is deemed insufficient to break the linear scaling relationship (LSR), which is the golden rule for the design of advanced catalysts. The discourse in this review intricately outlines the essence of heterogenous catalysis reactions by highlighting the vital roles played by electron properties. The physical and electrochemical properties of electron charge and spin that govern catalysis efficiencies are analyzed. Emphasis is placed on the pronounced influence of external fields in perturbing the LSR, underscoring the vital role that electron spin plays in advancing high-performance catalyst design. The review culminates by proffering insights into the potential applications of spin catalysis, concluding with a discussion of extant challenges and inherent limitations. This article is protected by copyright. All rights reserved.

Sci Total Environ (IF: 9.8) 2 ☒

Insight into the mechanism of nano-TiO2-doped biochar in mitigating cadmium mobility in soil-pak choi system.

Liu, He, et. al

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

Abstract:
Soil cadmium (Cd) pollution poses severe threats to food security and human health. Previous studies have reported that both nanoparticles (NPs) and biochar have potential for soil Cd remediation. In this study, a composite material (BN) was synthesized using low-dose TiO2 NPs and silkworm excrement-based biochar, and the mechanism of its effect on the Cd-contaminated soil-pak choi system was investigated. The application of 0.5 % BN to the soil effectively reduced 24.8 % of diethylenetriaminepentaacetic acid (DTPA) Cd in the soil and promoted the conversion of Cd from leaching and HOAc-extractive to reducible forms. BN could improve the adsorption capacity of soil for Cd by promoting the formation of humic acid (HA) and increasing the cation exchange capacity (CEC), as well as activating the oxygen-containing functional groups such as CO and CO. BN also increased soil urease and catalase activities and improved the synergistic network among soil bacterial communities to promote soil microbial carbon (C) and nitrogen (N) cycling, thus enhancing Cd passivation. Moreover, BN increased soil biological activity-associated metabolites like T-2 Triol and altered lipid metabolism-related fatty acids, especially hexadecanoic acid and dodecanoic acid, crucial for bacterial Cd tolerance. In addition, BN inhibited Cd uptake and root-to-shoot translocation in pak choi, which ultimately decreased Cd accumulation in shoots by 51.0 %. BN significantly increased the phosphorus (P) uptake in shoots by 59.4 % by improving the soil microbial P cycling. This may serve as a beneficial strategy for pak choi to counteract Cd toxicity. These findings provide new insights into nanomaterial-doped biochar for remediation of heavy metal contamination in soil-plant systems.

SOIL POLLUTION AND TREATMENT

Water Res (impact factor: 12.8) 1 区 TOP

ormation mechanism of persistent free radicals during pyrolysis of Fenton-conditioned sewage sludge: Influence of NOM and iron.

Li, Chen, et. al

Abstract:
The present study provided an innovative insight into the formation mechanism of persistent free radicals (PFRs) during the pyrolysis of Fenton-conditioned sludge. Fenton conditioners simultaneously improve the dewatering performance of sewage sludge and catalyze the pyrolysis of sewage sludge for the formation of PFRs. In this process, PFRs with a total number of spins of 9.533×1019 spins/g DS could be generated by pyrolysis of Fenton-conditioned sludge at 400°C. The direct thermal

decomposition of natural organic matter (NOM) fractions contributed to the formation of carbon-centered radicals, while the Maillard reaction produced phenols precursors. Additionally, the reaction between aromatic proteins and iron played a crucial role in the formation of phenoxyl or semiquinone-type radicals. Kinetics analysis using discrete distributed activation energy model (DAEM) demonstrated that the average activation energy for pyrolysis was reduced from 178.28 kJ/mol for raw sludge to 164.53 KJ/mol for Fenton conditioned sludge. The reaction factor (fi) indicated that the primary reaction in Fenton-conditioned sludge comprised of 27 parallel first-order reactions, resulting from pyrolysis cleavage of the NOM fractions, the Maillard reaction, and iron catalysis. These findings are significant for understanding the formation process of PFRs from NOM in Fenton-conditioned sludge and provide valuable insight for controlling PFRs formation in practical applications.

Sci Total Environ (impact factor: 9.8) 1 区 TOP

Converted paddy to upland in saline-sodic land could improve soil ecosystem multifunctionality by enhancing soil quality and alleviating microbial metabolism limitation.

Zhou, Lv, et al

Abstract:

Soil salinization is one of the major soil degradation threats worldwide, and parameters related to soil quality and ecosystem multifunctionality (EMF) are crucial for evaluating the success of reclamation efforts in saline-sodic wasteland (WL). Microbial metabolic limitation is also one of the main factors that influences EMF in agricultural cropping systems. A ten-year localization experiment was conducted to reveal the key predictors of soil quality index (SQI) values, microbial metabolic characteristics, and EMF in different farmland cropping systems. A random forest model showed that the β-glucosidase (BG), cellobiosidase (CBH) and saturated hydraulic conductivity (SHC) of the SQI factors were the main driving forces of soil EMF. Compared to monoculture models, such as paddy field (PF) or upland field (UF), the converted paddy field to upland field (CF) cropping system was most effective at improving EMF in reclaimed saline-sodic WL, increasing this metric by 275.35 %. CF integrates practices from both PF and UF planting systems, improved soil quality and relieves microbial metabolic limitation. Specifically, both CF and PF significantly reduced soil pH (by 16-23 %) and sodium adsorption ration (SAR) (by 65-83 %) and significantly reduced the abundance of large macroaggregates. Moreover, CF significantly improved soil saturated hydraulic conductivity relative to PF and UF ($p < 0.05$), indicating an improvement in soil physical properties. Overall, although reclamation improved SQI compared to WL (0.25), the EMF of CF (0.56) was significantly higher than that of other treatments ($p < 0.05$). Thus, while increasing SQI can improve soil EMF, it was not as effective alone as it was when combined with more comprehensive efforts that focus on improving various soil properties and alleviating microbial metabolic limitations.

Therefore, our results suggested that future saline-sodic wasteland reclamation efforts should avoid monoculture systems to enhance soil EMF.Copyright © 2024. Published by Elsevier B.V.

Sci Total Environ (impact factor: 9.8) 1 区 TOP

Mechanism and ecological environmental risk assessment of peroxymonosulfate for the treatment of heavy metals in soil.

Zhang, Long, et. al

Abstract:
Oxidation technologies based on peroxymonosulfate (PMS) have been effectively used for the remediation of soil organic pollutants due to their high efficiency. However, the effects of advanced PMS-based oxidation technologies on other soil pollutants, such as heavy metals, remain unknown. In this study, changes in the form of heavy metals in soil after using PMS and the risk of pollution to the ecological environment were investigated. Furthermore, two risk assessment methods, the mung bean germination toxicity test and groundwater leaching soil column test, were employed to evaluate the soil before and after PMS treatment. The results showed that PMS has a strong ability to degrade complex compounds, enabling the transformation of heavy metals, such as Cd, Pb, and Zn, from stable to active states in the soil. The risk assessments showed that PMS treatment activated heavy metals in the soil, which delayed the growth of plants, increased heavy metal content in plant tissues and the risk of groundwater pollution. These findings provide a new perspective for understanding the effects of PMS on soil, thus facilitating the sustained and reliable development of future research in the field of advanced oxidation applied to soil treatment.Copyright © 2024. Published by Elsevier B.V.

WASTEWATER TREATMENT

J Hazard Mater (impact factor: 13.6) 1 区 TOP

Elucidating the impacts of cobalt (II) ions on extracellular electron transfer and pollutant degradation by anodic biofilms in bioelectrochemical systems during industrial wastewater treatment.

Amanze, Wu, et. al

Abstract:
Electrogenic biofilms in bioelectrochemical systems (BES) are critical in wastewater

treatment. Industrial effluents often contain cobalt (Co2+); however, its impact on biofilms is unknown. This study investigated how increasing Co2+ concentrations (0-30 mg/L) affect BES biofilm community dynamics, extracellular polymeric substances, microbial metabolism, electron transfer gene expression, and electrochemical performance. The research revealed that as Co2+ concentrations increased, power generation progressively declined, from 345.43 ± 4.07 mW/m2 at 0 mg/L to 160.51 ± 0.86 mW/m2 at 30 mg/L Co2+. However, 5 mg/L Co2+ had less effect. The Co2+ removal efficiency in the reactors fed with 5 and 10 mg/L concentrations exceeded 99% and 94%, respectively. However, at 20 and 30 mg/L, the removal efficiency decreased substantially, likely because of reduced biofilm viability. FTIR indicated the participation of biofilm functional groups in Co2+ uptake. XPS revealed Co2+ presence in biofilms as CoO and Co(OH)2, indicating precipitation also aided removal. Cyclic voltammetry and electrochemical impedance spectroscopy tests revealed that 5 mg/L Co2+ had little impact on the electrocatalytic activity, while higher concentrations impaired it. Furthermore, at a concentration of 5 mg/L Co2+, there was an increase in the proportion of the genus Anaeromusa-Anaeroarcus, while the genus Geobacter declined at all tested Co2+ concentrations. Additionally, higher concentrations of Co2+ suppressed the expression of extracellular electron transfer genes but increased the expression of Co2+-resistance genes. Overall, this study establishes how Co2+ impacts electrogenic biofilm composition, function, and treatment efficacy, laying the groundwork for the optimized application of BES in remediating Co2+-contaminated wastewater.

J Hazard Mater (impact factor: 13.6) 1 区 TOP

Sensitivity and consistency of long- and short-read metagenomics and epicPCR for the detection of antibiotic resistance genes and their bacterial hosts in wastewater.

Lou, Fu, et. al

Abstract:

Wastewater surveillance is a powerful tool to assess the risks associated with antibiotic resistance in communities. One challenge is selecting which analytical tool to deploy to measure risk indicators, such as antibiotic resistance genes (ARGs) and their respective bacterial hosts. Although metagenomics is frequently used for analyzing ARGs, few studies have compared the performance of long-read and short-read metagenomics in identifying which bacteria harbor ARGs in wastewater. Furthermore, for ARG host detection, untargeted metagenomics has not been compared to targeted methods such as epicPCR. Here, we 1) evaluated long-read and short-read metagenomics as well as epicPCR for detecting ARG hosts in wastewater, and 2) investigated the host range of ARGs across the wastewater treatment plant (WWTP) to evaluate host proliferation. Results highlighted long-read revealed a wider range of ARG hosts compared to short-read metagenomics. Nonetheless, the ARG host range

detected by long-read metagenomics only represented a subset of the hosts detected by epicPCR. The ARG-host linkages across the influent and effluent of the WWTP were characterized. Results showed the ARG-host phylum linkages were relatively consistent across the WWTP, whereas new ARG-host species linkages appeared in the WWTP effluent. The ARG-host linkages of several clinically relevant species found in the effluent were identified.

Water Res (impact factor: 12.8) 1 区 TOP

Mechanistic insights into chemical conditioning on transformation of dissolved organic matter and plant biostimulants production during sludge aerobic composting.

Zhang, Yang, et. al

Abstract:

Inorganic coagulants (aluminum and iron salt) are widely used to improve sludge dewaterability, resulting in numerous residues in dewatered sludge. Composting refers to the controlled microbial process that converts organic wastes into fertilizer, and coagulant residues in dewatered sludge can affect subsequent compost efficiency and resource recycling, which remains unclear. This work investigated the effects of two typical metal salt coagulants (poly aluminum chloride [PAC] and poly ferric sulfate [PFS]) conditioning on sludge compost. Our results revealed that PAC conditioning inhibited composting with decreased peak temperature, microbial richness, enzymatic reaction intensities, and compost quality, associated with decreased pH and microbial toxicity of aluminum. Nevertheless, PFS conditioning selectively enriched Pseudoxanthomonas sp. and resulted in more fertile compost with increased peak temperature, enzymatic reaction intensities, and humification degree. Spectroscopy and mass difference analyses indicated that PFS conditioning enhanced reaction intensities of labile biopolymers at the thermophilic stage, mainly comprising hydrolyzation (H2O), dehydrogenation (-H2, -H4), oxidation (+O1H2), and other reactions (i.e., +CH2, C2H4O1, C2H6O1). Unlike the common composting process primarily conducts humification at the cooling stage, PFS conditioning changed the main occurrence stage to the thermophilic stage. Non-targeted metabolomics revealed that indole (a humification intermediate) is responsible for the increased humification degree and indoleacetic acid content in the PFS-conditioned compost, which then promoted compost quality. Plant growth experiments further confirmed that the dissolved organic matter (DOM) in PFS-conditioned compost produced the maximum plant biomass. This study provided molecular-level evidence that PFS conditioning can promote humification and compost fertility during sludge composting, enabling chemical conditioning optimization for sustainable management of sludge.

Nat Clim Chang (impact factor: 30.7) 1 ☒

The social costs of hydrofluorocarbons and the benefits from their expedited phase-down

Tammy Tan, Lisa Rennels, et. al

Abstract

Hydrofluorocarbons are a potent greenhouse gas, yet there remains a lack of quantitative estimates of their social cost. The present study addresses this gap by directly calculating the social cost of hydrofluorocarbons (SC-HFCs) using perturbations of exogenous inputs to integrated assessment models. We first develop a set of direct estimates of the SC-HFCs using methods currently adopted by the United States Government and then derive updated estimates that incorporate recent advances in climate science and economics. We compare our estimates with commonly used social cost approximations based on global warming potentials to show that the latter is a poor proxy for direct calculation of hydrofluorocarbon emissions impacts using integrated assessment models. Applying our SC-HFCs to the Kigali Amendment, a global agreement to phase down HFCs, we estimate that it provides US$202037 trillion in climate benefits over its lifetime. Expediting the phase-down could increase the estimated climate benefits to US$202041 trillion.

Nat Clim Chang (impact factor: 30.7) 1 ☒ TOP

Boreal–Arctic wetland methane emissions modulated by warming and vegetation activity

Kunxiaojia Yuan, Fa Li, et. al

Abstract

Wetland methane (CH4) emissions over the Boreal–Arctic region are vulnerable to climate change and linked to climate feedbacks, yet understanding of their long-term dynamics remains uncertain. Here, we upscaled and analysed two decades (2002–2021) of Boreal–Arctic wetland CH4 emissions, representing an unprecedented compilation of eddy covariance and chamber observations. We found a robust increasing trend of CH4 emissions (+8.9%) with strong inter-annual variability. The majority of emission increases occurred in early summer (June and July) and were mainly driven by warming (52.3%) and ecosystem productivity (40.7%). Moreover, a 2 °C temperature anomaly in 2016 led to the highest recorded annual CH4 emissions (22.3 Tg CH4 yr−1) over this region, driven primarily by high emissions over Western Siberian lowlands. However, current-generation models from the Global Carbon Project failed to capture the

emission magnitude and trend, and may bias the estimates in future wetland CH4 emission driven by amplified Boreal–Arctic warming and greening.

Bioresour Technol (impact factor: 11.4) 1 区 TOP

Greenhouse gas emission characteristics during kitchen waste composting with biochar and zeolite addition.

Geng, Yang, et. al

Abstract

Aerobic kitchen waste composting can contribute to greenhouse gas (GHGs) emissions and global warming. This study investigated the effects of biochar and zeolite on GHGs emissions during composting. The findings demonstrated that biochar could reduce N2O and CH4 cumulative releases by 47.7 %and 47.9 %, respectively, and zeolite could reduce the cumulative release of CO2 by 28.4 %. Meanwhile, the biochar and zeolite addition could reduce the abundance of potential core microorganisms associated with GHGs emissions. In addition, biochar and zeolite reduced N2O emissions by regulating the abundance of nitrogen conversion functional genes. Biochar and zeolite were shown to reduce the impact of bacterial communities on GHGs emissions. In summary, this study revealed that biochar and zeolite can effectively reduce GHG emissions during composting by altering the compost microenvironment and regulating microbial community structure. Such findings are valuable for facilitating high-quality resource recovery of organic solid waste.

ECOSYSTEMS

Science (impact factor: 56.9) 1 区 TOP

Diversity begets stability: Sublinear growth and competitive coexistence across ecosystems.

Hatton, Mazzarisi, et. al

Abstract

The worldwide loss of species diversity brings urgency to understanding how diverse ecosystems maintain stability. Whereas early ecological ideas and classic observations suggested that stability increases with diversity, ecological theory makes the opposite prediction, leading to the long-standing "diversity-stability debate." Here, we show that this puzzle can be resolved if growth scales as a sublinear power law with biomass (exponent <1), exhibiting a form of population self-regulation analogous to models of individual ontogeny. We show that competitive interactions among populations with

sublinear growth do not lead to exclusion, as occurs with logistic growth, but instead promote stability at higher diversity. Our model realigns theory with classic observations and predicts large-scale macroecological patterns. However, it makes an unsettling prediction: Biodiversity loss may accelerate the destabilization of ecosystems.

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

Integration Analysis of Single-Cell Multi-Omics Reveals Prostate Cancer Heterogeneity.

Bian, Wang, et. al

Abstract:
Prostate cancer (PCa) is an extensive heterogeneous disease with a complex cellular ecosystem in the tumor microenvironment (TME). However, the manner in which heterogeneity is shaped by tumors and stromal cells, or vice versa, remains poorly understood. In this study, single-cell RNA sequencing, spatial transcriptomics, and bulk ATAC-sequence are integrated from a series of patients with PCa and healthy controls. A stemness subset of club cells marked with SOX9high ARlow expression is identified, which is markedly enriched after neoadjuvant androgen-deprivation therapy (ADT). Furthermore, a subset of CD8+ CXCR6+ T cells that function as effector T cells is markedly reduced in patients with malignant PCa. For spatial transcriptome analysis, machine learning and computational intelligence are comprehensively utilized to identify the cellular diversity of prostate cancer cells and cell-cell communication in situ. Macrophage and neutrophil state transitions along the trajectory of cancer progression are also examined. Finally, the immunosuppressive microenvironment in advanced PCa is found to be associated with the infiltration of regulatory T cells (Tregs), potentially induced by an FAP+ fibroblast subset. In summary, the cellular heterogeneity is delineated in the stage-specific PCa microenvironment at single-cell resolution, uncovering their reciprocal crosstalk with disease progression, which can be helpful in promoting PCa diagnosis and therapy.© 2024 The Authors. Advanced Science published by Wiley-VCH GmbH.

PLoS Comput Biol (impact factor: 4.3) 2 ☒ TOP

Unlocking ensemble ecosystem modelling for large and complex networks.

Vollert, Drovandi, et. al

Abstract:
The potential effects of conservation actions on threatened species can be predicted using ensemble ecosystem models by forecasting populations with and without intervention. These model ensembles commonly assume stable coexistence of species

in the absence of available data. However, existing ensemble-generation methods become computationally inefficient as the size of the ecosystem network increases, preventing larger networks from being studied. We present a novel sequential Monte Carlo sampling approach for ensemble generation that is orders of magnitude faster than existing approaches. We demonstrate that the methods produce equivalent parameter inferences, model predictions, and tightly constrained parameter combinations using a novel sensitivity analysis method. For one case study, we demonstrate a speed-up from 108 days to 6 hours, while maintaining equivalent ensembles. Additionally, we demonstrate how to identify the parameter combinations that strongly drive feasibility and stability, drawing ecological insight from the ensembles. Now, for the first time, larger and more realistic networks can be practically simulated and analysed.

Ⅱ Concentration

PHYSICS

Variance sum rule for entropy production

I. Di Terlizzi, M. Gironella, et al.

Abstract

Entropy production is the hallmark of nonequilibrium physics, quantifying irreversibility, dissipation, and the efficiency of energy transduction processes. Despite many efforts, its measurement at the nanoscale remains challenging. We introduce a variance sum rule (VSR) for displacement and force variances that permits us to measure the entropy production rate σ in nonequilibrium steady states. We first illustrate it for directly measurable forces, such as an active Brownian particle in an optical trap. We then apply the VSR to flickering experiments in human red blood cells. We find that σ is spatially heterogeneous with a finite correlation length, and its average value agrees with calorimetry measurements. The VSR paves the way to derive σ using force spectroscopy and time-resolved imaging in living and active matter.

Light-driven nanoscale vectorial currents

Pettine, Jacob, et al.

Abstract

Controlled charge flows are fundamental to many areas of science and technology, serving as carriers of energy and information, as probes of material properties and dynamics[1] and as a means of revealing[2,3] or even inducing[4,5] broken symmetries. Emerging methods for light-based current control[5,6,7,8,9,10,11,12,13,14,15,16] offer particularly promising routes beyond the speed and adaptability limitations of conventional voltage-driven systems. However, optical generation and manipulation of currents at nanometre spatial scales remains a basic challenge and a crucial step towards scalable optoelectronic systems for microelectronics and information science. Here we introduce vectorial optoelectronic metasurfaces in which ultrafast light pulses induce local directional charge flows around symmetry-broken plasmonic nanostructures, with tunable responses and arbitrary patterning down to subdiffractive nanometre scales. Local symmetries and vectorial currents are revealed by polarization-dependent and wavelength-sensitive electrical readout and terahertz (THz) emission, whereas spatially tailored global currents are demonstrated in the direct generation of elusive broadband THz vector beams[17]. We show that, in graphene, a detailed interplay between

electrodynamic, thermodynamic and hydrodynamic degrees of freedom gives rise to rapidly evolving nanoscale driving forces and charge flows under the extremely spatially and temporally localized excitation. These results set the stage for versatile patterning and optical control over nanoscale currents in materials diagnostics, THz spectroscopies, nanomagnetism and ultrafast information processing.

Non-Abelian topological order and anyons on a trapped-ion processor

Iqbal, Mohsin, et al.

Abstract

Non-Abelian topological order is a coveted state of matter with remarkable properties, including quasiparticles that can remember the sequence in which they are exchanged[1,2,3,4]. These anyonic excitations are promising building blocks of fault-tolerant quantum computers[5,6]. However, despite extensive efforts, non-Abelian topological order and its excitations have remained elusive, unlike the simpler quasiparticles or defects in Abelian topological order. Here we present the realization of non-Abelian topological order in the wavefunction prepared in a quantum processor and demonstrate control of its anyons. Using an adaptive circuit on Quantinuum's H2 trapped-ion quantum processor, we create the ground-state wavefunction of D_4 topological order on a kagome lattice of 27 qubits, with fidelity per site exceeding 98.4 per cent. By creating and moving anyons along Borromean rings in spacetime, anyon interferometry detects an intrinsically non-Abelian braiding process. Furthermore, tunnelling non-Abelions around a torus creates all 22 ground states, as well as an excited state with a single anyon—a peculiar feature of non-Abelian topological order. This work illustrates the counterintuitive nature of non-Abelions and enables their study in quantum devices.

MATERIALS

Homogeneous crystallization and buried interface passivation for perovskite tandem solar modules

Han Gao, Ke Xiao, et al.

Abstract

Scalable fabrication of all-perovskite tandem solar cells is challenging because the narrow-bandgap subcells made of mixed lead-tin (Pb-Sn) perovskite films suffer from nonuniform crystallization and inferior buried perovskite interfaces. We used a dopant

from Good's list of biochemical buffers, aminoacetamide hydrochloride, to homogenize perovskite crystallization and used it to extend the processing window for blade-coating Pb-Sn perovskite films and to selectively passivate defects at the buried perovskite interface. The resulting all-perovskite tandem solar module exhibited a certified power conversion efficiency of 24.5% with an aperture area of 20.25 square centimeters.

High fatigue resistance in a titanium alloy via near-void-free 3D printing

Qu, Zhan, et al.

Abstract

The advantage of 3D printing—that is, additive manufacturing (AM) of structural materials—has been severely compromised by their disappointing fatigue properties[1,2]. Commonly, poor fatigue properties appear to result from the presence of microvoids induced by current printing process procedures[3,4]. Accordingly, the question that we pose is whether the elimination of such microvoids can provide a feasible solution for marked enhancement of the fatigue resistance of void-free AM (Net-AM) alloys. Here we successfully rebuild an approximate void-free AM microstructure in Ti-6Al-4V titanium alloy by development of a Net-AM processing technique through an understanding of the asynchronism of phase transformation and grain growth. We identify the fatigue resistance of such AM microstructures and show that they lead to a high fatigue limit of around 1 GPa, exceeding the fatigue resistance of all AM and forged titanium alloys as well as that of other metallic materials. We confirm the high fatigue resistance of Net-AM microstructures and the potential advantages of AM processing in the production of structural components with maximum fatigue strength, which is beneficial for further application of AM technologies in engineering fields.

Monolithic silicon for high spatiotemporal translational photostimulation

Li, Pengju, et al.

Abstract

Electrode-based electrical stimulation underpins several clinical bioelectronic devices, including deep-brain stimulators1,2 and cardiac pacemakers3. However, leadless multisite stimulation is constrained by the technical difficulties and spatial-access limitations of electrode arrays. Optogenetics offers optically controlled random access with high spatiotemporal capabilities, but clinical translation poses challenges4,5,6. Here we show tunable spatiotemporal photostimulation of cardiac systems using a non-genetic platform based on semiconductor-enabled biomodulation interfaces. Through spatiotemporal profiling of photoelectrochemical currents, we assess the magnitude, precision, accuracy and resolution of photostimulation in four leadless silicon-based

monolithic photoelectrochemical devices. We demonstrate the optoelectronic capabilities of the devices through optical overdrive pacing of cultured cardiomyocytes (CMs) targeting several regions and spatial extents, isolated rat hearts in a Langendorff apparatus, in vivo rat hearts in an ischaemia model and an in vivo mouse heart model with transthoracic optical pacing. We also perform the first, to our knowledge, optical override pacing and multisite pacing of a pig heart in vivo. Our systems are readily adaptable for minimally invasive clinical procedures using our custom endoscopic delivery device, with which we demonstrate closed-thoracic operations and endoscopic optical stimulation. Our results indicate the clinical potential of the leadless, lightweight and multisite photostimulation platform as a pacemaker in cardiac resynchronization therapy (CRT), in which lead-placement complications are common.

CHEMISTRY

Stable anchoring of single rhodium atoms by indium in zeolite alkane dehydrogenation catalysts

Lei Zeng, Kang Cheng, et. al

Abstract

Maintaining the stability of single-atom catalysts in high-temperature reactions remains extremely challenging because of the migration of metal atoms under these conditions. We present a strategy for designing stable single-atom catalysts by harnessing a second metal to anchor the noble metal atom inside zeolite channels. A single-atom rhodium-indium cluster catalyst is formed inside zeolite silicalite-1 through in situ migration of indium during alkane dehydrogenation. This catalyst demonstrates exceptional stability against coke formation for 5500 hours in continuous pure propane dehydrogenation with 99% propylene selectivity and propane conversions close to the thermodynamic equilibrium value at 550°C. Our catalyst also operated stably at 600°C, offering propane conversions of >60% and propylene selectivity of >95%.

Aminative Suzuki–Miyaura coupling

Polpum Onnuch, Kranthikumar Ramagonolla, et. al

Abstract

The Suzuki–Miyaura and Buchwald–Hartwig coupling reactions are widely used to form carbon-carbon (C–C) and carbon-nitrogen (C–N) bonds, respectively. We report the incorporation of a formal nitrene insertion process into the Suzuki–Miyaura reaction,

altering the products from C–C–linked biaryls to C–N–C–linked diaryl amines and thereby joining the Suzuki–Miyaura and Buchwald–Hartwig coupling pathways to the same starting-material classes. A combination of a bulky ancillary phosphine ligand on palladium and a commercially available amination reagent enables efficient reactivity across aryl halides and pseudohalides, boronic acids and esters, and many functional groups and heterocycles. Mechanistic insights reveal flexibility on the order of bond-forming events, suggesting potential for expansion of the aminative cross-coupling concept to encompass diverse nucleophiles and electrophiles as well as four-component variants.

Site-specific reactivity of stepped Pt surfaces driven by stress release

Liu, Guangdong, et. al

Abstract

Heterogeneous catalysts are widely used to promote chemical reactions. Although it is known that chemical reactions usually happen on catalyst surfaces, only specific surface sites have high catalytic activity. Thus, identifying active sites and maximizing their presence lies at the heart of catalysis research[1,2,3,4], in which the classic model is to categorize active sites in terms of distinct surface motifs, such as terraces and steps[1,5,6,7,8,9,10]. However, such a simple categorization often leads to orders of magnitude errors in catalyst activity predictions and qualitative uncertainties of active sites[7,8,11,12], thus limiting opportunities for catalyst design. Here, using stepped Pt(111) surfaces and the electrochemical oxygen reduction reaction (ORR) as examples, we demonstrate that the root cause of larger errors and uncertainties is a simplified categorization that overlooks atomic site-specific reactivity driven by surface stress release. Specifically, surface stress release at steps introduces inhomogeneous strain fields, with up to 5.5% compression, leading to distinct electronic structures and reactivity for terrace atoms with identical local coordination, and resulting in atomic site-specific enhancement of ORR activity. For the terrace atoms flanking both sides of the step edge, the enhancement is up to 50 times higher than that of the atoms in the middle of the terrace, which permits control of ORR reactivity by either varying terrace widths or controlling external stress. Thus, the discovery of the above synergy provides a new perspective for both fundamental understanding of catalytically active atomic sites and design principles of heterogeneous catalysts.

BIOLOGY

Native architecture of a human GBP1 defense complex for cell-autonomous immunity to infection

Shiwei Zhu, Clinton J. Bradfield, et al.

Abstract

All living organisms deploy cell-autonomous defenses to combat infection. In plants and animals, large supramolecular complexes often activate immune proteins for protection. In this work, we resolved the native structure of a massive host-defense complex that polymerizes 30,000 guanylate-binding proteins (GBPs) over the surface of gram-negative bacteria inside human cells. Construction of this giant nanomachine took several minutes and remained stable for hours, required guanosine triphosphate hydrolysis, and recruited four GBPs plus caspase-4 and Gasdermin D as a cytokine and cell death immune signaling platform. Cryo–electron tomography suggests that GBP1 can adopt an extended conformation for bacterial membrane insertion to establish this platform, triggering lipopolysaccharide release that activated coassembled caspase-4. Our "open conformer" model provides a dynamic view into how the human GBP1 defense complex mobilizes innate immunity to infection.

Defective pollen tube tip growth induces neo-polyploid infertility

Jens Westermann, Thanvi Srikant, et. al

Abstract

Genome duplication (generating polyploids) is an engine of novelty in eukaryotic evolution and a promising crop improvement tool. Yet newly formed polyploids often have low fertility. Here we report that a severe fertility-compromising defect in pollen tube tip growth arises in new polyploids of Arabidopsis arenosa. Pollen tubes of newly polyploid A. arenosa grow slowly, have aberrant anatomy and disrupted physiology, often burst prematurely, and have altered gene expression. These phenotypes recover in evolved polyploids. We also show that gametophytic (pollen tube) genotypes of two tip-growth genes under selection in natural tetraploid A. arenosa are strongly associated with pollen tube performance in the tetraploid. Our work establishes pollen tube tip growth as an important fertility challenge for neo-polyploid plants and provides insights into a naturally evolved multigenic solution.

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The immunopathological landscape of human pre-TCRα deficiency: From rare to common variants

Marie Materna, Ottavia M. Delmonte, et. al

Abstract

We describe humans with rare biallelic loss-of-function PTCRA variants impairing pre–α T cell receptor (pre-TCRα) expression. Low circulating naive αβ T cell counts at birth persisted over time, with normal memory αβ and high γδ T cell counts. Their TCRα repertoire was biased, which suggests that noncanonical thymic differentiation pathways can rescue αβ T cell development. Only a minority of these individuals were sick, with infection, lymphoproliferation, and/or autoimmunity. We also report that 1 in 4000 individuals from the Middle East and South Asia are homozygous for a common hypomorphic PTCRA variant. They had normal circulating naive αβ T cell counts but high γδ T cell counts. Although residual pre-TCRα expression drove the differentiation of more αβ T cells, autoimmune conditions were more frequent in these patients compared with the general population.

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Ⅲ Calling for papers

ICGET 2024

Submission deadline: **Mar 30, 2024**
Conference date: **Jul 21, 2024 - Jul 23, 2024**
Full name: **International Conference on Green Energy Technologies**
Location: **Berlin, Germany**
Website: http://www.icget.org/

Welcome to the 9th International Conference on Green Energy Technologies to be held during July 21-23, 2024 in Berlin, Germany. ICGET serves to foster communication among researchers and practitioners working in a wide variety of scientific areas with a common interest. The conference is also an excellent forum for scientists, engineers throughout the world to present and discuss the latest technological advancement as well as future directions and trends in the field. The conference has been held in various cities including Frankfurt, Rome, Amsterdam, Kuala Lumpur, etc., hope to see you in 2024!

Call for papers:
The conference is soliciting state-of-the-art research papers in different scientific fileds related to Green Energy Technologies.

ESRE 2024

Submission deadline: **Feb 5, 2024**
Conference date: **Apr 9, 2024 - Apr 12, 2024**
Full name: **6th International Conference on Environmental Sciences and Renewable Energy**
Location: **Tokyo Institute of Technology, Japan**
Website: http://www.icmda.org

2024 6th International Conference on Environmental Sciences and Renewable Energy (ESRE 2024) is going to be held during June 28-30, 2024 in Frankfurt, Germany.

ESRE 2024 aims to provide a forum for researchers, practitioners, and professinals from the industry, academia and government to discourse on research and development, professionals practice in the field of Environmental Sciences and Renewable Energy. We welcome researchers, engineers, students, industry, investors and people from all walks of life interested in

Environmental Sciences and Renewable Energy to attend the conference and share your experiences and lessons with other enthusiasts, and develop opportunities for cooperation.

Topics of Interest :
ESRE 2024 solicits high quality papers of Environmental Sciences and Renewable Energy including, but not limited to:

Environmental Ecological Engineering

►Global environmental change and ecosystems management;
Integrated ecosystems management;Environmental restoration and ecological engineering;
Habitat reconstruction;
Biodiversity conservation;
Deforestation;Wetlands

Resources and Environmental Engineering

►Water Resources Management and Water Pollution Control;
Atmospheric science and air pollution control;
Solid Waste Pollution Control and Resource Utilization;
Ground water remediation;
Solid waste management;
Water treatment and reclamation;
Solid waste management

ICSTM 2024

Submission deadline:	**Apr 5, 2024**
Conference date:	**Aug 23, 2024 - Aug 25, 2024**
Full name:	**International Conference on Sustainable Tourism Management**
Location:	**Munich, Germany**
Website:	http://www.icstm.org/

2024 8th International Conference on Sustainable Tourism Management (ICSTM 2024) will be held in Munich, Germany during August 23-25, 2024. The conference was initiated in 2017 and held in Barcelona, Spain, then Amsterdam, The Netherlands in 2018, Budapest, Hungary in 2019, virtual

mode in 2020, 2021 due to the covid-19 epidemic, Stockholm in 2022, and Copenhagen in 2023. It aims to provide a forum for researchers, practitioners, and professionals from both the industry and the academia to share their newest research findings and results in the filed of sustainable tourism management.

Call for Papers:
Tourism strategies
Environmental issues
Community issues
Climate change
Safety and security
Tourism as a tool of development
Art, architecture and culture
Heritage tourism
Wildlife and adventure tourism
Health and wellbeing tourism
Medical tourism
Marine and coastal areas tourism

For more details, please visit at http://www.icstm.org/cfp.html

ICREE 2024

Submission deadline:	**Feb 23, 2024**
Conference date:	**Sep 27, 2024 - Sep 29, 2024**
Full name:	**International Conference on Renewable Energy and Environment**
Location:	**Ankara, Turkey**
Website:	https://www.icree.org/

2024 8th International Conference on Renewable Energy and Environment (ICREE 2024) will be held in Ankara, Turkey on September 27-29, 2024.
It delightfully welcomes all the researchers and developers to share their experience and ideas through research talks and presentations from diverse fields in renewable energy and environment. This event offers a platform in bringing together a forum for students, postdocs and established scientists to exchange their ideas and contribute an integrative approach to renewable energy and environment.
The scopes of ICREE 2024 include Wind Energy Applications, Technology and System Aspects, Wind Resources Environmental Impact, Machines and Wind Farms, Hydropower Applications, etc.

Publication
Submissions will be reviewed by at least two conference technical committees or international reviewers, and accepted papers will be published into in a volume of E3S Web of Conferences (eISSN: 2267-1242), which is now indexed by Scopus, CPCI (Web of Science), CAS, DOAJ, EBSCO, ProQuest

***Call for papers:**
Topics of interest for submission include, but are not limited to:
*Wind Resources Environmental Impact
*Hydropower Applications
*Construction and Design Issues
*Environmental Impact Assessment
*Solar Cell Technology
*PV for Rural Development
*Solar Thermal Electricity
*Geothermal Applications

More Topics, please visit at: https://www.icree.org/cfp.html

ICBMM 2024

Submission deadline:	**Apr 25, 2024**
Conference date:	**Sep 10, 2024 - Sep 12, 2024**
Full name:	**International Conference on Building Materials and Materials Engineering**
Location:	**Madrid, Spain**
Website:	http://www.icbmm.org

Rapid development of modern technology needs the support of new material. New material together with information and energy are known as the three pillars of modern science and technology. The birth of new materials will lead rapid development of related industries and technologies. Architecture is one of the examples. The appearance of new building materials not only enhanced the original performance of the materials, such as durability, mechanical properties but also the performance of strength, energy conservation, insulation, waterproof, and appearance. Construction materials is developing towards the pursuit of functional diversity, life-cycle economy and recycling. With the change of living concepts and the demand of the multifarious building function, as the very basic elements of construction, building materials will face plenty of challenges.
ICBMM 2024 is organized after ICBMM 2023 (Porto, Portugal, September 14-16, 2023), ICBMM

2022 (Barcelona, Spain, September 15-17, 2022), ICBMM 2021 (Virtual, September 24-26, 2021), ICBMM 2020 (Virtual, September 24-26, 2020), ICBMM 2019 (NOVA University of Lisbon, Portugal, September 25-27, 2019), ICBMM 2018 (University of Lisbon, Portugal, September 26-28, 2018) and ICBMM 2017 (Lyon, France, September 21-23, 2017). ICBMM will focus on research hotspot like building materials, semiconducting materials, organic/polymer materials, nano-materials, composite materials, bio-materials and etc. The conference aims to provide opportunities for the delegates to exchange new ideas and application experiences face to face, to establish business or research relations and to find global partners for future collaboration.

Topics of interest

~Environmental Materials Science and Engineering
Metallic Alloys, Tool Materials
Multifunctional Materials
Smart Materials

~Environmental Materials Properties, Measuring Methods and Applications
Fracture Mechanics, Mechanical Properties
Corrosion, Erosion, Wear Resistance
Working Properties of Materials and Products

~Environmental Materials Manufacturing and Processing
Welding, Sintering, Heat Treatment
Thin & Thick Coatings
Automation Engineering Processes

~Civil and Structural Engineering
Construction and Control;Detection and Transformation
Safety and Monitoring;Sanitary and Ground Water Engineering
Transportation Engineering;Tunnel, Subway and Underground Facilities

~Architecture and Urban Planning
Building Technology Science
Advanced Construction Materials
Green Building Materials

More topics, please go to: https://www.icbmm.org/cfp.html

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