Hot Articles

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Science & Technology

Title: Biomimetic and bioinspired approaches for wiring enzymes to electrode interfaces

Author: Patrick O. Saboe, Emelia Conte, Megan Farell, Guillermo C. Bazan and Manish Kumar

Journal: Energy & Environmental Science

Volume: 10 **Issue:** 1 **Page:** 14-42

Doi: 10.1039/C6EE02801B

Abstract

Biomimetic and bioinspired approaches to redox enzyme wiring involve borrowing structures and strategies found in biological electron transfer systems for use in engineered devices. Redox protein–electrode systems are evolving for several applications, including energy, biomedical and environmental purposes. This review is intended to be both “tutorial” and comprehensive in that we provide a guide to understand, design, and improve electrode interfaces for redox enzyme electron transfer processes in devices. The review examines electrode interfaces by directly comparing them with biological electron transfer systems. First, the mechanisms, theory, and structures for electron transfer in biological systems are provided, followed by analysis of the strategies and structures engineered in redox-protein devices. The review describes the challenges of constructing and applying redox enzyme devices, including the poor electrical contact between electrodes and enzymes and low lifetime and scalability of devices.

Database

RSC

Title: Alternative strategy for a safe rechargeable battery

Author: M. H. Braga, N. S. Grundish, A. J. Murchison and J. B. Goodenough

Journal: Energy & Environmental Science

Volume: 10 **Issue:** 1 **Page:** 331-336

Doi: 10.1039/C6EE02888H

Abstract

The advent of a Li^+ or Na^+ glass electrolyte with a cation conductivity $\sigma_i > 10^{-2}$ S cm^{-1} at 25 °C and a motional enthalpy ΔH_m = 0.06 eV that is wet by a metallic lithium or sodium anode is used to develop a new strategy for an all-solid-state, rechargeable, metal-plating battery. During discharge, a cell plates the metal of an anode of high-energy Fermi level such as lithium or sodium onto a cathode current collector with a low-energy Fermi level; the voltage of the cell may be determined by a cathode redox center having an energy between the Fermi levels of the anode and that of the cathode current collector. This strategy is demonstrated with a solid electrolyte that not only is wet by the metallic anode, but also has a dielectric constant capable of creating a large electric-double-layer capacitance at the two electrode/electrolyte interfaces. The result is a safe, low-cost, lithium or sodium rechargeable battery of high energy density and long cycle life.

Database

RSC

Title: Potential-induced degradation in photovoltaic modules: a critical review

Author: Wei Luo, Yong Sheng Khoo, Peter Hacke, Volker Naumann, Dominik Lausch, Steven P. Harvey, Jai Prakash Singh, Jing Chai, Yan Wang, Armin G. Aberle and Seeram Ramakrishna

Journal: Energy & Environmental Science

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Doi: 10.1039/C6EE02271E

Abstract

Potential-induced degradation (PID) has received considerable attention in recent years due to its detrimental impact on photovoltaic (PV) module performance under field conditions. Both crystalline silicon (c-Si) and thin-film PV modules are susceptible to PID. While extensive studies have already been conducted in this area, the understanding of the PID phenomena is still incomplete and it remains a major problem in the PV industry. Herein, a critical review of the available literature is given to serve as a one-stop source for understanding the current status of PID research. This paper also aims to provide an overview of future research paths to address PID-related issues. This paper consists of three parts. In the first part, the modelling of leakage current paths in the module package is discussed. The PID mechanisms in both c-Si and thin-film PV modules are also comprehensively reviewed. The second part summarizes various test methods to evaluate PV modules for PID. The last part focuses on studies related to PID in the omnipresent p-type c-Si PV modules. The dependence of temperature, humidity and voltage on the progression of PID is examined. Preventive measures against PID at the cell, module and system levels are illustrated. Moreover, PID recovery in standard p-type c-Si PV modules is also studied. Most of the findings from p-type c-Si PV modules are also applicable to other PV module technologies.

Database

RSC

Title: Land management: data availability and process understanding for global change studies

Author: Karl-Heinz Erb, Sebastiaan Luyssaert, Patrick Meyfroidt, Julia Pongratz, Axel Don, Silvia Kloster, Tobias Kuemmerle, Tamara Fetzel, Richard Fuchs, Martin Herold, Helmut Haberl, Chris D. Jones, Erika Marín-Spiotta, Ian McCallum, Eddy Robertson, Verena Seufert, Steffen Fritz, Aude Valade, Andrew Wiltshire and Albertus J. Dolman

Journal: Global Change Biology

Volume: 23 **Issue:** 2 **Page:** 512–533

Doi: 10.1111/gcb.13443

Abstract

In the light of daunting global sustainability challenges such as climate change, biodiversity loss and food security, improving our understanding of the complex dynamics of the Earth system is crucial. However, large knowledge gaps related to the effects of land management persist, in particular those human-induced changes in terrestrial ecosystems that do not result in land-cover conversions. Here, we review the current state of knowledge of ten common land management activities for their biogeochemical and biophysical impacts, the level of process understanding and data availability. Our review shows that ca. one-tenth of the ice-free land surface is under intense human management, half under medium and one-fifth under extensive management. Based on our review, we cluster these ten management activities into three groups: (i) management activities for which data sets are available, and for which a good knowledge base exists (cropland harvest and irrigation); (ii) management activities for which sufficient knowledge on biogeochemical and biophysical effects exists but robust global data sets are lacking (forest harvest, tree species selection, grazing and mowing harvest, N fertilization); and (iii) land management practices with severe data gaps concomitant with an unsatisfactory level of process understanding (crop species selection, artificial wetland drainage, tillage and fire management and crop residue management, an element of crop harvest). Although we identify multiple impediments to progress, we conclude that the current status of process understanding and data availability is sufficient to advance with incorporating management in, for example, Earth system or dynamic vegetation models in order to provide a systematic assessment of their role in the Earth system. This review contributes to a strategic prioritization of research efforts across multiple disciplines, including land system research, ecological research and Earth system modelling.

Database

Wiley Online Library

Title: Heat resistance throughout ontogeny: body size constrains thermal tolerance

Author: Michael Klockmann, Franziska Günter and Klaus Fischer

Journal: Global Change Biology

Volume: 23 **Issue:** 2 **Page:** 686–696

Doi: 10.1111/gcb.13407

Abstract

Heat tolerance is a trait of paramount ecological importance and may determine a species' ability to cope with ongoing climate change. Although critical thermal limits have consequently received substantial attention in recent years, their potential variation throughout ontogeny remained largely neglected. We investigate whether such neglect may bias conclusions regarding a species' sensitivity to climate change. Using a tropical butterfly, we found that developmental stages clearly differed in heat tolerance. It was highest in pupae followed by larvae, adults and finally eggs and hatchlings. Strikingly, most of the variation found in thermal tolerance was explained by differences in body mass, which may thus impose a severe constraint on adaptive variation in stress tolerance. Furthermore, temperature acclimation was beneficial by increasing heat knock-down time and therefore immediate survival under heat stress, but it affected reproduction negatively. Extreme temperatures strongly reduced survival and subsequent reproductive success even in our highly plastic model organism, exemplifying the potentially dramatic impact of extreme weather events on biodiversity. We argue that predictions regarding a species' fate under changing environmental conditions should consider variation in thermal tolerance throughout ontogeny, variation in body mass and acclimation responses as important predictors of stress tolerance.

Database

Wiley Online Library

Title: Global variations in ecosystem-scale isohydricity

Author: Alexandra G. Konings and Pierre Gentine

Journal: Global Change Biology

Volume: 23 **Issue:** 2 **Page:** 891–905

Doi: 10.1111/gcb.13389

Abstract

Droughts are expected to become more frequent and more intense under climate change. Plant mortality rates and biomass declines in response to drought depend on stomatal and xylem flow regulation. Plants operate on a continuum of xylem and stomatal regulation strategies from very isohydric (strict regulation) to very anisohydric. Coexisting species may display a variety of isohydricity behaviors. As such, it can be difficult to predict how to model the degree of isohydricity at the ecosystem scale by aggregating studies of individual species. This is nonetheless essential for accurate prediction of ecosystem drought resilience. In this study, we define a metric for the degree of isohydricity at the ecosystem scale in analogy with a recent metric introduced at the species level. Using data from the AMSR-E satellite, this metric is evaluated globally based on diurnal variations in microwave vegetation optical depth (VOD), which is directly related to leaf water potential. Areas with low annual mean radiation are found to be more anisohydric. Except for evergreen broadleaf forests in the tropics, which are very isohydric, and croplands, which are very anisohydric, land cover type is a poor predictor of ecosystem isohydricity, in accordance with previous species-scale observations. It is therefore also a poor basis for parameterizing water stress response in land-surface models. For taller ecosystems, canopy height is correlated with higher isohydricity (so that rainforests are mostly isohydric). Highly anisohydric areas show either high or low underlying water use efficiency. In seasonally dry locations, most ecosystems display a more isohydric response (increased stomatal regulation) during the dry season. In several seasonally dry tropical forests, this trend is reversed, as dry-season leaf-out appears to coincide with a shift toward more anisohydric strategies. The metric developed in this study allows for detailed investigations of spatial and temporal variations in plant water behavior.

Database

Wiley Online Library

Title: Estimating Causal Effects of Local Air Pollution on Daily Deaths: Effect of Low Levels

Author: Schwartz, Joel; Bind, Marie-Abele; Koutrakis, Petros

Journal: Environmental Health Perspectives

Volume: 125 **Issue:** 1 **Page:** 23-29

Doi: 10.1289/EHP232

Abstract

BACKGROUND: Although many time-series studies have established associations of daily pollution variations with daily deaths, there are fewer at low concentrations, or focused on locally generated pollution, which is becoming more important as regulations reduce regional transport. Causal modeling approaches are also lacking. OBJECTIVE: We used causal modeling to estimate the impact of local air pollution on mortality at low concentrations. METHODS: Using an instrumental variable approach, we developed an instrument for variations in local pollution concentrations that is unlikely to be correlated with other causes of death, and examined its association with daily deaths in the Boston, Massachusetts, area. We combined height of the planetary boundary layer and wind speed, which affect concentrations of local emissions, to develop the instrument for particulate matter ≥2.5 μm (PM[sub 2.5]), black carbon (BC), or nitrogen dioxide (NO2) variations that were independent of year, month, and temperature. We also used Granger causality to assess whether omitted variable confounding existed. RESULTS: We estimated that an interquartile range increase in the instrument for local PM[sub 2.5] was associated with a 0.90% increase in daily deaths (95% CI: 0.25, 1.56). A similar result was found for BC, and a weaker association with NO[sub 2] The Granger test found no evidence of omitted variable confounding for the instrument. A separate test confirmed the instrument was not associated with mortality independent of pollution. Furthermore, the association remained when all days with PM[sub 2.5] concentrations > 30 μg/m[sup 3] were excluded from the analysis (0.84% increase in daily deaths; 95% CI: 0.19, 1.50). CONCLUSIONS: We conclude that there is a causal association of local air pollution with daily deaths at concentrations below U.S. EPA standards. The estimated attributable risk in Boston exceeded 1,800 deaths during the study period, indicating that important public health benefits can follow from further control efforts.

Database

Academic Search Complete

Title: Implementation Science to Accelerate Clean Cooking for Public Health

Author: Rosenthal, Joshua; Balakrishnan, Kalpana; Bruce, Nigel; Chambers, David; Graham, Jay; Jack, Darby; Kline, Lydia; Masera, Omar; Mehta, Sumi; Mercado, Ilse Ruiz; Neta, Gila; Pattanayak, Subhrendu; Puzzolo, Elisa; Petach, Helen; Punturieri, Antonello; Rubinstein, Adolfo; Sage, Michael; Sturke, Rachel; Shankar, Anita; Sherr, Kenny

Journal: Environmental Health Perspectives

Volume: 125 **Issue:** 1 **Page:** pA3-A7

Doi: 10.1289/EHP1018

Abstract

SUMMARY: Clean cooking has emerged as a major concern for global health and development because of the enormous burden of disease caused by traditional cookstoves and fires. The World Health Organization has developed new indoor air quality guidelines that few homes will be able to achieve without replacing traditional methods with modern clean cooking technologies, including fuels and stoves. However, decades of experience with improved stove programs indicate that the challenge of modernizing cooking in impoverished communities includes a complex, multi-sectoral set of problems that require implementation research. The National Institutes of Health, in partnership with several government agencies and the Global Alliance for Clean Cookstoves, has launched the Clean Cooking Implementation Science Network that aims to address this issue. In this article, our focus is on building a knowledge base to accelerate scale-up and sustained use of the cleanest technologies in low- and middle-income countries. Implementation science provides a variety of analytical and planning tools to enhance effectiveness of clinical and public health interventions. These tools are being integrated with a growing body of knowledge and new research projects to yield new methods, consensus tools, and an evidence base to accelerate improvements in health promised by the renewed agenda of clean cooking.

Database

Academic Search Complete

Title: Assessing the transport potential of polymeric nanocapsules developed for crop protection

Author: Adamo Riccardo Petosa, Faraz Rajput, Olivia Selvam, Carolin Öhl, Nathalie Tufenkji

Journal: Water Research

Volume: 111 **Issue:** - **Page:** 10–17

Doi: 10.1016/j.watres.2016.12.030

Abstract

Nanotechnology is increasingly important in the agricultural sector, with novel products being developed to heighten crop yields and increase pesticide efficacy. Herein, the transport potential of different polymeric nanocapsules (*n*CAPs) developed as pesticide delivery vehicles was assessed in model soil systems. The *n*CAPs examined are (i) poly(acrylic acid)-based (*n*CAP1), (ii) poly(methacrylic acid)-*ran*-poly(ethyl acrylate) copolymer-based (*n*CAP2), (iii) poly(methacrylic acid-*ran*-styrene) copolymer-based (*n*CAP3), and (iv) poly(methacrylic acid-*ran*-butylmethacrylate)-based (*n*CAP4). *n*CAP mobility was examined in columns packed with agricultural loamy sand saturated with artificial porewater containing Ca^{2+} and Mg^{2+} cations (10 mM ionic strength, pH 6 and 8). Furthermore, the impact of (i) cation species, (ii) sand type, and (iii) ammonium polyphosphate fertilizer on the transport potential of a nanoformulation combining *n*CAP4 capsules and the pyrethroid bifenthrin (*n*CAP4-BIF) was examined and compared to a commercial bifenthrin formulation (Capture® LFR). Although *n*CAP4-BIF and Capture® LFR formulations were highly mobile in quartz sand saturated with 10 mM $NaNO_3$ (≥95% elution), they were virtually immobile in the presence of 10% ammonium polyphosphate fertilizer. The presence of Ca^{2+} and Mg^{2+} did not hinder *n*CAP4-BIF elution in quartz sand saturated with 10 mM standard CIPAC D synthetic porewater; however, limited Capture® LFR transport (<10% elution) was observed under the same conditions. Capture® LFR also exhibited limited mobility in the presence or absence of fertilizer in loamy sand saturated with divalent salt solutions, whereas *n*CAP4-BIF exhibited increased elution with time and enhanced transport upon the addition of fertilizer. Overall, *n*CAP4 is a promising delivery vehicle in pyrethroid nanoformulations such as *n*CAP4-BIF.

Database

ScienceDirect

Title: Removal of antibiotic resistance genes from wastewater treatment plant effluent by coagulation

Author: Na Li, Guo-Ping Sheng, Yong-Ze Lu, Raymond J. Zeng, Han-Qing Yu

Journal: Water Research

Volume: 111 **Issue:** - **Page:** 204–212

Doi: 10.1016/j.watres.2017.01.010

Abstract

Antibiotic resistance genes (ARGs), as emerging environmental contaminants, have become a threat to human health. Recent studies have demonstrated that the effluent from wastewater treatment plants is a significant point source of ARGs released into the environment. In this study, we investigated the effectiveness of coagulation technology in the removal of ARGs from treated wastewater. Specifically, we measured the removal of five ARGs (two sulfonamide resistance genes, *sulI* and *sulII*, and three tetracycline resistance genes, *tetO*, *tetW* and *tetQ*) and the class 1 integron *intI1* gene via the application of two coagulants: $FeCl_3$ and polyferric chloride (PFC). Moreover, the removal of dissolved organic carbon (DOC), NH_3—N and total phosphorus (TP) in the coagulation process was investigated. The coagulation process effectively removed ARGs from the effluent with 0.5-log to 3.1-log reductions. Significant removal correlations were observed between dissolved NH_3—N and DOC, *intI1* and *sulI*, *sulII* and *tetO*, *sulII* and *tetW*, and *tetO* and *tetW*, implying that the co-removal of DOC, dissolved NH_3—N, the *intI1* gene and different ARGs played an important role in ARG loss during coagulation with Fe-based coagulants. These results indicate that coagulation may play a promising role in ARG reduction in wastewater treatment plants.

Database

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