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材料科学Materials Science

Blood-catalyzed n-doped polymers for reversible optical neural control

血液催化n型掺杂聚合物用于可逆光学神经调控

▲ 作者：SANKET SAMAL, SHULAN XIAO, SAMANTHA NELSON, OM KOLHE, HAMMAD F. KHAN, MEISAM HABIBI MATIN, ET AL.

▲链接：

https://www.science.org/doi/10.1126/science.adu5500

▲摘要：

将合成材料与活体组织实现生物相容性的融合，仍是生物电子学领域面临的一大难题。在这种情况下，无基底导电聚合物（CP）界面或有助于弥合这一差距。

研究组报道了在清醒的斑马鱼和小鼠体内利用全血催化聚合的方式对n型掺杂的聚（苯并二呋喃二酮）（n-PBDF）进行的体内自组装过程。这种方法利用内源性催化剂（特别是血红蛋白），来形成稳定且对热和离子敏感的CP网络，确保其在整个生命周期内都具有长期相容性。

研究组通过使用近红外（NIR）光进行可逆、细胞和亚细胞水平的神经调节（包括在体内聚合n-PBDF）来展示这种界面的效果。电生理学研究证实，n-PBDF可改变原生钠离子通道的兴奋性，并且近红外光刺激通过热离子诱导的分流作用放大了这种调节作用，从而实现了按需、毫秒级可逆的兴奋性抑制控制，这一特性在行为活跃小鼠中也得到了验证。

▲ Abstract：

Biocompatible integration of synthetic materials with living tissue remains a major challenge for bioelectronics. In this case, substrate-free conducting polymer (CP) interfaces could help bridge this gap. We report in vivo assembly of n-doped poly(benzodifurandione) (n-PBDF) using whole blood – catalyzed polymerization in awake zebrafish and mice. This approach leverages endogenous catalysts, specifically hemoproteins, to form stable, thermally and ionically sensitive CP networks, ensuring long-term compatibility throughout the lifespan. We showcase the impact of this interface through reversible, cellular, and subcellular neuromodulation using near-infrared (NIR) light, including in vivo polymerized n-PBDF. Electrophysiological studies confirmed that n-PBDF alters intrinsic sodium ion channel excitability, and NIR light stimulation amplifies this modulation through thermoionic-induced shunting, providing on-demand, millisecond-scale reversible inhibitory control of excitability, a feature recapitulated in actively behaving mice.

Atomic-resolution imaging of gold species at organic liquid-solid interfaces

有机液—固界面处金物种的原子分辨率成像

▲ 作者：SAM SULLIVAN-ALLSOP, NICK CLARK, WENDONG WANG, RONGSHENG CAI,

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▲链接：

https://www.science.org/doi/10.1126/science.adw2469

▲摘要：

固液界面处吸附态原子的结构和动力学特性决定了高级催化剂、电化学装置、分子分离技术以及废料流金属提取等领域的性能。然而，由于成像分辨率不足以及溶剂不相容等原因，学界一直很难开展在各种化学环境中原子级分散的金属原位研究。

研究组将液相电子显微镜原子分辨率的样品设计与深度学习分析相结合，以探究金吸附原子团、石墨基底以及溶剂之间的相互作用。他们追踪了超过106个以石墨为基底的金吸附原子、双原子以及更大尺寸团簇在五种溶剂中的分布位点。尽管其初始原子分布由溶剂的极性所决定，但仍需低温快速干燥动力学来优化催化性能。

▲ Abstract：

The structure and dynamics of adsorbed atoms (adatoms) at solid-liquid interfaces determine the performance of advanced catalysts, electrochemical devices, molecular separation technologies, and metal extraction from waste streams. However, in situ investigations of atomically dispersed metals in various chemical environments have been prevented by insufficient imaging resolution and solvent incompatibility. In this study, we combined a specimen design that provides atomic resolution in liquid-phase electron microscopy with deep learning – enabled analysis to explore the interactions between gold adatoms, graphite support, and the solvent collectively. We tracked the locations of >106 graphite-supported gold adatoms, dimers, and larger clusters in five solvents. Although their initial atomic dispersion was determined by the solvent polarity, fast drying kinetics at low temperature was required for optimizing catalytic performance.

A 36-ring zeolite with intrinsic cylindrical mesopores

具有本征圆柱形介孔的36环沸石

▲ 作者：JIAZHENG SUN, XUDONG TIAN, ZHENGHAN ZHANG, JING LIU, LEI HAN, FANRONG XU, ET AL.

▲链接：

https://www.science.org/doi/10.1126/science.aec4882

▲摘要：

稳定的超大孔沸石在催化和分子分离方面极具应用价值，但大多数仍为微孔结构，这限制了其对大体积底物的适用性。在少数具有介孔结构的超大孔沸石中，其孔隙通常呈现为细长、非圆形的孔道结构。

研究组报告称，NJU120-6是一种具有本征圆柱形介孔结构的稳定硅酸盐沸石，拥有当前尺寸最大的36环孔隙窗口，自由直径为25.71埃×19.12埃。

NJU120-6的骨架密度最低，为每立方纳米9.39个硅原子，其孔容积为每克0.66立方厘米，在温度高达1173开尔文时仍能够维持稳定，可掺入铝和钛元素，从而在催化裂化以及大分子液相烯烃氧化反应中展现出优异性能。

▲ Abstract：

Stable extra-large-pore zeolites are highly desirable for catalysis and molecular separation, but most remain microporous, limiting their effectiveness for bulky substrates. Among the few extra-large-pore zeolites that exhibit mesoporosity, the pores typically form as elongated, noncircular pore apertures. We report that NJU120-6, a stable silicate zeolite with an intrinsic cylindrical mesoporous system, has the currently largest 36-ring windows with a free diameter of 25.71 angstroms by 19.12 angstroms. NJU120-6 exhibits the lowest framework density of 9.39 silicon atoms per cubic nanometer and a pore volume of 0.66 cubic centimeters per gram. It remains stable up to 1173 kelvin and can incorporate aluminum and titanium, enabling superior performance in catalytic cracking and in liquid-phase alkene oxidation of bulky molecules, respectively.

化学Chemistry

Bromine-mediated electrochemical propane dehydrogenation by self-assembled ionic liquid-SnO2 hollow spheres

自组装离子液体-SnO2空心球催化溴介导电化学丙烷脱氢

▲ 作者：JIARUI YANG, ZHIHAO PEI, BO-CHAO YE, WEN-HAO LI, HAN YAN, DEYAN LUAN, ET AL.

▲链接：

https://www.science.org/doi/10.1126/science.aed2309

▲摘要：

传统的热丙烷脱氢（PDH）工艺存在一些显著缺陷，包括能耗高、结焦导致的催化剂失活以及需要进行产物分离。

研究组报道了一种利用自组装离子液体（IL）-二氧化锡（SnO2）空心球作为电催化剂的电催化方法，在常温下实现了高效PDH。在这个过程中，丙烷在阳极电解液中生成的溴丙烷会与阴极处的羟基阴离子发生反应生成丙烯。

丙烯的选择性超过98%，通过阳极电解液连续产出高纯度（>99%）的丙烯气体，而无需后续分离纯化。这种IL-
SnO2催化剂可保持其活性和选择性超过6000小时，且电压增幅仅为每小时3.16微伏。

机理研究表明，IL层能够增强丙烷的吸附效果，并促进相邻锡位点上的碳氢键活化步骤。反应结束后，IL层会促进丙烯的解吸，并抑制深度脱氢副反应。

▲ Abstract：

Conventional thermal propane dehydrogenation (PDH) faces several notable drawbacks, including high energy requirements, coking-induced catalyst deactivation, and the need for product separation. An electrocatalytic approach, using self-assembled ionic liquid (IL) – tin dioxide (SnO_2) hollow spheres as the electrocatalyst, enables efficient PDH at ambient temperature. In this process, bromopropane formed in the anolyte from propane reacts with hydroxyl anions from the cathode to yield propene. The propene selectivity exceeds 98%, and the continuous production of high-purity (>99%) propene gas from the anolyte eliminates the need for downstream separation. The IL-SnO_2 catalyst maintains its activity and selectivity for more than 6000 hours, with a small voltage increase rate of 3.16 microvolts per hour. Mechanistic studies suggest that the IL layer enhances propane adsorption and facilitates the carbon-hydrogen bond activation step on adjacent Sn sites. After reaction, the IL layer promotes propene desorption and suppresses deep dehydrogenation.

地球科学Earth Science

Onset of millennial climate variability with the intensification of Northern Hemisphere glaciation

随着北半球冰川作用加剧，千年尺度气候变化开始显现

▲ 作者：DAVID A. HODELL, F á TIMA ABRANTES, CARLOS A. ALVAREZ ZARIKIAN, TIMOTHY D. HERBERT, MENGYAO DU, SIMON J. CROWHURST, ET AL.

▲链接：

https://www.science.org/doi/10.1126/science.ady7970

▲摘要：

第四纪时期（过去约258万年）的特征是北半球大型冰原的消长进退。通过研究伊比利亚海沿岸的沉积物序列，研究组证实，大约270万年前北半球冰盖的扩张伴随着冰川期内千年尺寸气候变化（MCV）的出现。

MCV在约270万年前初现端倪，伴随着一系列孤立的前兆事件，随后在约250万年前又出现了多次千年尺度的气候振荡。这些事件与北大西洋中浮冰碎屑沉积的情况相吻合，这表明海洋型冰盖发挥了重要作用。一旦形成，MCV便成为第四纪冰川气候的一个固有特征。

该研究结果表明，北半球冰川作用对多时间尺度上的气候变化产生了深远影响。

▲ Abstract：

The Quaternary Period (the past 2.58 million years) was characterized by the waxing and waning of large ice sheets in the Northern Hemisphere. Using sediment sequences from the Iberian Margin, we have demonstrated that expansion of Northern Hemisphere ice sheets around 2.7 million years ago was accompanied by the emergence of millennial climate variability (MCV) during glacial periods. The onset of MCV at ~2.7 million years ago was heralded by isolated precursor events, followed by multiple millennial climate oscillations at ~2.5 million years ago. These events coincided with deposition of ice-rafted detritus in the North Atlantic, suggesting a role for marine-terminating ice sheets. Once established, MCV became an intrinsic feature of glacial climates of the Quaternary. Our findings underscore the profound impact Northern Hemisphere glaciation had on climate variability across multiple timescales.

环境科学Environmental Science

Strategies for achieving healthy, sustainable, and equitable dietary transitions

实现健康、可持续且公平的饮食转型策略

▲ 作者：YI YANG, DAVID TILMAN, MARC F. BELLEMARE, JESSICA FANZO, CAROLA GREBITUS, KELLY L. HAWS, ET AL.

▲链接：

https://www.science.org/doi/10.1126/science.adr7162

▲摘要：

全球食品系统的工业化进程导致了对健康和环境都有害的饮食结构变革。若要全球食品体系满足不断增长的人口对健康、环境可持续且价格合理的饮食需求，就亟需进行深度改革。

这篇综述中，研究组汇总了越来越多的实证数据，揭示了影响消费者饮食选择和农民生产决策的多重复杂因素，尤其是公共和私营实体在塑造食品环境方面发挥的作用。研究组概述了有前景的干预措施，以帮助促进全球饮食的有益转型，包括食品创新研发、食品环境监管、食品援助和食药项目。

了解并协调各类食品体系参与者的动机和激励机制，对于实现更优的健康、环境和社会公平目标至关重要。

▲ Abstract：

The industrialization of global food systems has led to dietary changes that harm both health and the environment. If global food systems are to meet the needs of a growing population for healthy, environmentally sustainable, and affordable diets, substantial changes will be required. In this Review, we synthesize growing empirical evidence on the complexity of factors that influence consumer dietary and farmer production choices, especially the roles of public and private entities that shape food environments. We outline promising interventions to help facilitate beneficial global dietary transitions, including research

and development for product innovation, regulation of food environments, and food assistance and food-as-medicine programs. Understanding and aligning the motives and incentives of various food system actors is essential to achieve improved health, environment, and equity outcomes.

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