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材料科学Materials Science

事件响应型扫描透射电子显微镜

▲ 作者：JONATHAN J. P. PETERS, BRYAN W. REED, YU JIMBO, KANAKO NOGUCHI, KARIN H. MÜLLER, ALEXANDRA PORTER, ET AL.

▲ 链接：

<https://www.science.org/doi/10.1126/science.ado8579>

▲ 摘要：

透射电子显微镜一个长期存在的限制是高能电子与任何样品相互作用所造成的损伤。

通过重新考虑成像的基本原理，研究组展示了一种电子显微镜的事件响应策略，可为给定光束流提供有关样品的更多信息。通过测量达到电子计数阈值的时间，而非等待预定义的常数时间，可提高每个电子获得的信息。

显微镜通过遮蔽光束来响应这些事件，从而减少所需的总剂量。该方法自动分配剂量，以在每个像素中实现给定的信噪比，消除了与信息收益递减相关的过量剂量。通过成像生物组织和沸石，研究组证明了该策略对光束敏感材料的广泛适用性。

▲ Abstract：

An ever-present limitation of transmission electron microscopy is the damage caused by high-energy

electrons interacting with any sample. By reconsidering the fundamentals of imaging, we demonstrate an event-responsive approach to electron microscopy that delivers more information about the sample for a given beam current. Measuring the time to achieve an electron count threshold rather than waiting a predefined constant time improves the information obtained per electron. The microscope was made to respond to these events by blanking the beam, thus reducing the overall dose required. This approach automatically apportions dose to achieve a given signal-to-noise ratio in each pixel, eliminating excess dose that is associated with diminishing returns of information. We demonstrate the wide applicability of our approach to beam-sensitive materials by imaging biological tissue and zeolite.

Nuclei engineering for even halide distribution in stable perovskite/silicon tandem solar cells

晶核工程助力稳定钙钛矿/硅串联太阳能电池中卤化物均匀分布

▲ 作者：YIHUA CHEN, NING YANG, GUANHAOJIE ZHENG, FENGTAO PEI, WENTAO ZHOU, YU ZHANG, ET AL.

▲ 链接：

<https://www.science.org/doi/10.1126/science.ado9104>

▲ 摘要：

串联结构的宽带隙（WBG）吸收剂结晶度差、织构弱，在实际运行中导致了严重的混合卤化物—阳离子迁移和相分离。

研究组通过在任何富溴聚集体和2H相形成之前使3C相成核，来控制对成分不敏感的WBG膜生长。所得WBG吸收剂具有改善的结晶度和较强的织构，抑制了非辐射复合，增强了对各种老化应力的抵抗力。

钙钛矿/硅串联太阳能电池的功率转换效率在25 cm²有效面积内为29.4%（第三方评估为28.8%），在1 cm²有效面积内为32.5%。这些太阳能电池在封装后，在25°C最大功率点（AM 1.5G照明，全光谱，1太阳）下运行1301小时后，保持了98.3%的初始效率；而在50°C最大功率点下运行800小时后，亦保持了90%的初始效率。

▲ Abstract :

Wide-bandgap (WBG) absorbers in tandem configurations suffer from poor crystallinity and weak texture, which leads to severe mixed halide-cation ion migration and phase segregation during practical operation. We control WBG film growth insensitive to compositions by nucleating the 3C phase before any formation of bromine-rich aggregates and 2H phases. The resultant WBG absorbers show improved crystallinity and strong texture with suppressed nonradiative recombination and enhanced resistance to various aging stresses. Perovskite/silicon tandem solar cells achieve power conversion efficiencies of 29.4% (28.8% assessed by a third party) in a 25 – square centimeter active area and 32.5% in a 1 – square centimeter active area. These solar cells retained 98.3 and 90% of the original efficiency after 1301 and 800 hours of operation at 25 ° and 50 ° C, respectively, at the maximum power point (AM 1.5G illumination, full spectrum, 1-sun) when encapsulated.

Additive manufacturing of highly entangled polymer networks

高度缠结聚合物网络的增材制造

▲ 作者：ABHISHEK P. DHAND, MATTHEW D. DAVIDSON, HANNAH M. ZLOTNICK, THOMAS J. KOLIBABA, JASON P. KILLGORE AND JASON A. BURDICK

▲ 链接：

<https://www.science.org/doi/10.1126/science.adn6925>

▲摘要：

在单个网络中掺入聚合物链缠结可协同提高刚度和韧性，但通过诸如数字光处理（DLP）的光聚合固化增材制造来实现如此密集的缠结仍难以实现。

研究组报道了一种结合了光聚合和暗聚合的简单策略，使组成聚合物链在印刷结构中形成时能够紧密缠绕。

这种可推广的方法在室温下实现了高单体转化率，而不需要额外刺激（如打印后的光或热），并且可实现高度缠结的水凝胶和弹性体的增材制造，其延伸能量比传统DLP高出4到7倍。研究组使用这种方法打印了具有空间编程粘附湿组织特征的高分辨率和多材料结构。

▲ Abstract：

Incorporation of polymer chain entanglements within a single network can synergistically improve stiffness and toughness, yet attaining such dense entanglements through vat photopolymerization additive manufacturing [e.g., digital light processing (DLP)] remains elusive. We report a facile strategy that combines light and dark polymerization to allow constituent polymer chains to densely entangle as they form within printed structures. This generalizable approach reaches high monomer conversion at room temperature without the need for additional stimuli, such as light or heat after printing, and enables additive manufacturing of highly entangled hydrogels and elastomers that exhibit fourfold- to sevenfold-higher extension energies in comparison to that of traditional DLP. We used this method to print high-resolution and multimaterial structures with features such as spatially programmed adhesion to wet tissues.

化学Chemistry

A molecular anion pump

分子阴离子泵

▲ 作者：BAIHAO SHAO, HEYIFEI FU AND IVAN APRAHAMIAN

▲ 链接：

<https://www.science.org/doi/10.1126/science.adp3506>

▲ 摘要：

通过基于蛋白质的转运体逆浓度梯度泵送离子是许多生物过程的基石。使用人工受体来模拟该功能仍是一项艰巨挑战，这主要因为在高结合亲和力的要求与精确按需离子捕获和释放特性之间难以权衡。

研究组报道了一种基于三聚脒光开关的受体，通过在二氯甲烷液膜中逆浓度梯度主动输送氯阴离子，将光能转化为功，起到了分子泵的作用。该系统具有易于合成、双稳定性、优异的光开关性能和优异的ON-OFF结合性能（差异可达6个数量级）。

▲ Abstract：

Pumping ions against a concentration gradient through protein-based transporters is a cornerstone of numerous biological processes. Mimicking this function by using artificial receptors remains a daunting challenge, mainly because of the difficulties in balancing between the requirement for high binding affinities and precise and on-demand ion capture and release properties. We report a trimeric hydrazone photoswitch-based receptor that converts light energy into work by actively transporting chloride anion against a gradient through a dichloromethane liquid membrane, functioning as a molecular pump. The system manifests ease of synthesis, bistability, excellent photoswitching properties, and superb ON-OFF binding properties (difference of up to six orders of magnitude).

地球科学Earth Science

Recent tropical Andean glacier retreat is unprecedented in the Holocene

近期热带安第斯冰川的退缩在全新世是前所未有的

▲ 作者：ANDREW L. GORIN, JEREMY D. SHAKUN, ANDREW G. JONES, TORI M. KENNEDY, SHAUN A. MARCOTT, BRENT M. GOEHRING, ET AL.

▲ 链接：

<https://www.science.org/doi/10.1126/science.adg7546>

▲ 摘要：

近几十年来，热带冰川已经退缩，但这种退缩幅度是否超过了全新世波动的范围尚不明确。

研究组测量了横跨热带安第斯山脉的四处冰川边缘最近暴露的基岩中铍-10和碳-14的浓度，以重建其相对于今天的过去范围。所有样本的核素浓度都几乎为零，表明这些位置在全新世期间从未暴露过。

该数据表明，现在热带地区的许多冰川可能比至少11700年前以来的冰川要小，这使得热带地区成为第一个记录该里程碑的大地区。

▲ Abstract：

Tropical glaciers have retreated over recent decades, but whether the magnitude of this retreat exceeds the bounds of Holocene fluctuations is unclear. We measured cosmogenic beryllium-10 and carbon-14

concentrations in recently exposed bedrock at the margin of four glaciers spanning the tropical Andes to reconstruct their past extents relative to today. Nuclide concentrations are near zero in almost all samples, suggesting that these locations were never exposed during the Holocene. Our data imply that many glaciers in the tropics are probably now smaller than they have been in at least 11,700 years, making the tropics the first large region where this milestone has been documented.

Mid-Pleistocene climate transition triggered by Antarctic Ice Sheet growth

南极冰盖生长引发中更新世气候转型

▲ 作者：ZHISHENG AN, WEIJIAN ZHOU, ZEKE ZHANG, XU ZHANG, ZHONGHUI LIU, YOUNBIN SUN, ET AL.

▲ 链接：

<https://www.science.org/doi/10.1126/science.abn4861>

▲ 摘要：

尽管人们进行了广泛的研究，但中更新世气候转型的性质和原因仍然是个谜。

在这项工作中，研究组通过综合与半球冰盖演化相关的更新世中高纬度代用记录，来评估其与两极冰盖异步发展的联系。该研究结果表明，南极冰盖（AISs）在200万至125万年前大幅增长，早于北半球冰盖在约125万年前之后的快速扩张。

代理模型比较表明，AIS和相关的南大洋海冰扩张可导致北部高纬度地区变冷，并增强向北半球的水汽输送，从而引发中更新世气候转型。所涉及的动态过程对于评估已引发异步两极冰盖融化的现代全球变暖至关重要。

▲ Abstract :

Despite extensive investigation, the nature and causes of the Mid-Pleistocene Transition remain enigmatic. In this work, we assess its linkage to asynchronous development of bipolar ice sheets by synthesizing Pleistocene mid- to high-latitude proxy records linked to hemispheric ice sheet evolution. Our results indicate substantial growth of the Antarctic Ice Sheets (AISs) at 2.0 to 1.25 million years ago, preceding the rapid expansion of Northern Hemisphere Ice Sheets after ~1.25 million years ago. Proxy-model comparisons suggest that AIS and associated Southern Ocean sea ice expansion can induce northern high-latitude cooling and enhanced moisture transport to the Northern Hemisphere, thus triggering the Mid-Pleistocene Transition. The dynamic processes involved are crucial for assessing modern global warming that is already inducing asynchronous bipolar melting of ice sheets.

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