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天文学Astronomy

A native sulfur deposit in Gale crater, Mars

火星盖尔陨石坑中的原生硫矿床

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▲ 链接：

<https://www.science.org/doi/10.1126/science.adu5501>

▲ 摘要：

火星岩石含有含硫物种，包括硫酸盐和硫化物。这些化合物记录了火星地质演化过程中运行的硫循环。研究者利用“好奇”号探测器对火星盖尔陨石坑内盖迪兹谷地的一片浅色石块矿床进行了调查，发现这些石块由天然硫组成。该硫矿床似乎在盖迪兹谷地底部一条蜿蜒嵌入的峡谷内就地

形成。

天然硫的存在表明，古代火星上存在涉及浮力地下流体的硫富集路径。他们提出，该硫的主要来源是岩浆蒸气，这些蒸气在近地表冰冻圈中冷却，并在盖迪兹谷地侵蚀过程中通过减压作用释放出来。

▲ Abstract :

Martian rocks are known to contain sulfur-bearing species, including sulfates and sulfides. These compounds record a sulfur cycle that operated over the geological evolution of Mars. We used the Curiosity rover to investigate a deposit of light-toned stones in Gediz Vallis within Gale crater on Mars and found that the stones are composed of native sulfur. The sulfur deposit appears to have formed in place, within a sinuous entrenched canyon cut into the floor of Gediz Vallis. The presence of native sulfur implies that a sulfur enrichment pathway involving buoyant subsurface fluids operated on ancient Mars. We propose that the primary source of this sulfur was magmatic vapor, which cooled in the near subsurface cryosphere and was released by decompression during the erosion of Gediz Vallis.

物理学Physics

Ultralong sheathed single-metal-atom chains synthesized under high pressure

高压下合成的超长鞘状单金属原子链

▲ 作者：JIE ZHANG, XIAO DONG, SHENGCHAO QIU, XIN YANG, CHENGYU LI, HONGFEI MA, YUNFAN FEI, QINGCHAO ZENG, FANG LI, AND KUO LI, ect.

▲ 链接：

<https://www.science.org/doi/10.1126/science.aeg0028>

▲ 摘要：

单金属原子链（SMACs）代表了一维纳米结构的终极极限。它们既是凝聚态物理研究的典型模型体系，也是下一代纳米电子学的基本构建单元。然而，合成适用于实际应用单金属原子链仍然具有挑战性。

研究者通过将 β -铜酞菁压缩至21吉帕以上，以毫克级规模制备了微米级长度的碳包覆铜单金属原子链。这些单金属原子链具有原子尺度的有序性，可通过酸辅助剥离法分离，并表现出卓越的稳定性，Cu-Cu距离被限制在2.57埃。实验和计算结果提示其具有各向异性电导和反铁磁相互作用。

研究建立了一种普适性的包覆型单金属原子链合成策略，使其成为未来电子学和自旋电子学应用的一个极具前景的平台。

▲ Abstract :

Single-metal-atom chains (SMACs) represent the ultimate limit of one-dimensional nanostructures. They serve as archetypal model systems for condensed matter physics and constitute fundamental building blocks for next-generation nanoelectronics. However, synthesis of SMACs suitable for practical applications remains challenging. In this work, we create micrometer-long, carbon-sheathed copper SMACs at milligram scale by compressing β -copper phthalocyanine to above 21 gigapascals. The SMACs are in atom-scale ordering, are isolable through acid-assisted exfoliation, and exhibit exceptional stability, with Cu-Cu distance confined at 2.57 angstroms. Anisotropic conductance and antiferromagnetic interactions are suggested by experimental and computational results. This work establishes a universal synthetic strategy for sheathed SMACs, positioning them as a compelling platform for prospective electronic and spintronic applications.

化学物理Chemical Physics

Preferred synthesis of armchair transition metal dichalcogenide nanotubes

扶手椅型过渡金属二硫化物纳米管的优选合成

▲ 作者 : ABID, LUNENG ZHAO, JU HUANG, YONGJIA ZHENG, YUTA SATO, TIANYU WANG, DMITRY LEVSHOV, LINGFENG WANG, HAIMING SUN, AND RONG XIANG, etc.

▲ 链接 :

<https://www.science.org/doi/10.1126/science.aeh1429>

▲ 摘要 :

纳米管是一类重要的晶体材料，但控制其结构，尤其是手性，仍然是一个根本性挑战。研究报道了一种合成具有优选扶手椅手性的过渡金属二硫化物纳米管的策略。

二硫化锡、二硫化钼和二硫化钨纳米管在氮化硼纳米管通道内以高产率和结构纯度形成。原子分辨率成像、电子衍射和圆二色性显示扶手椅型偏好高达83%。密度泛函理论排除了结构稳定性作为这一偏好的起源，但证实了锯齿形纳米带在能量上更稳定。

机器学习势分子动力学模拟表明，锯齿形纳米带卷曲形成扶手椅型纳米管，这一过程随后通过原位透射电子显微镜被观测到。研究有助启发实现各种特定手性纳米管的按需合成。

▲ Abstract :

Nanotubes represent an important class of crystalline materials, but controlling their structures, particularly chiralities, remains a fundamental challenge. In this work, we report a strategy for synthesizing transition metal dichalcogenide nanotubes with preferred armchair chirality. Tin disulfide, molybdenum disulfide, and tungsten disulfide nanotubes were formed with high yield and structural purity inside boron nitride nanotube channels. Atomic-resolution imaging, electron diffraction, and circular dichroism revealed an armchair

preference up to 83%. Density functional theory ruled out structural stability as the origin of this preference but confirmed that zigzag nanoribbons are energetically more stable. Machine learning potential molecular dynamics simulated that zigzag nanoribbons roll up to form armchair nanotubes, a process that was subsequently observed by in situ transmission electron microscope. This work may inspire the achievement of on-demand synthesis of various nanotubes with specific chiralities.

Laser Mössbauer spectroscopy of ²²⁹Th in CaF₂

CaF₂中²²⁹Th的激光穆斯堡尔光谱学

▲ 作者：TAKAHIRO HIRAKI, TAKAHIKO MASUDA, SAYURI TAKATORI, FABIAN SCHADEN, MICHAEL BARTOKOS, KJELD BEEKS, YUTA FUKUNAGA, ANDREAS GRÜNEIS, MING GUAN, AND KOJI YOSHIMURA, etc.

▲ 链接：

<https://www.science.org/doi/10.1126/science.aea7978>

▲ 摘要：

原子钟是世界上最精确的计时工具，但依赖于原子核能级之间跃迁的核钟可能被证明更加实用。科学家们长期以来一直关注一个特定的原子核——钍-229，因为它的跃迁与激光频率兼容。特别有前景的是固态核钟，其中钍原子核被嵌入氟化钙等固体中。然而，固体内部电场梯度的存在导致原子核能级分裂。

研究者对掺入氟化钙单晶中的钍-229的核钟跃迁进行了激光穆斯堡尔光谱学测量。根据光谱，研究人员确定了晶体中钍离子的四种不同掺杂位点，并表征了它们各自不同的电场环境。该技术为原子核环境提供了强大的探测手段，为设计未来的固态核钟提供了基础数据。

▲ Abstract：

Atomic clocks are the world's most precise timekeepers, but nuclear clocks, which depend on transitions between nuclear energy levels, might prove even more useful. Scientists have long focused on a particular nucleus, that of thorium-229, because its transitions are compatible with laser frequencies. Particularly promising are solid-state nuclear clocks in which thorium nuclei are embedded within a solid such as calcium fluoride. However, the presence of electric field gradients inside the solid leads to the splitting of nuclear energy levels. Hiraki et al. performed laser Mössbauer spectroscopy of the nuclear clock transitions of thorium-229 doped into calcium fluoride single crystals. Based on the spectra, the researchers identified four distinct doping sites for thorium ions within the crystal and characterized their distinct electric field environments.

植物生物学Plant Biology

Genomes of Poaceae relatives reveal key metabolic innovations preceding the evolution of grasses

禾本科近缘物种基因组揭示草类演化前夕的关键代谢创新

▲ 作者：YURI TAKEDA-KIMURA, BETHANY MOORE, SAMUEL HOLDEN, JAE S. MORRIS, SONTOSH K. DEB, CARLY SANDERS, JORGE EL-AZAZ, MATT BARRETT, DAVID LORENCE, AND HIROSHI A. MAEDA, etc.

▲ 链接：

<https://www.science.org/doi/10.1126/science.adv0443>

▲ 摘要：

禾本科植物包含许多重要的经济粮食作物，并在多样化的生态系统中扮演初级生产者的角色。它们也表现出独特的代谢特征，例如在质体和细胞质中均能合成淀粉，以及能够同时利用苯丙氨酸和酪氨酸合成木质素。然而，这些特征的演化起源一直不清楚。

研究对禾本科植物的姐妹类群进行了基因组测序，发现尽管部分胞质淀粉合成基因是在禾本科内部出现的，但一个关键的质体膜转运蛋白的出现要早于它们的演化。一次早于禾本科特异性全基因组复制的串联重复事件，催生了具有双功能的苯丙氨酸/酪氨酸解氨酶，从而使得禾本科植物能够进行双重木质素生物合成。

▲ Abstract：

Grasses include many economically important food crops and function as primary producers in diverse ecosystems. They also exhibit distinctive metabolic traits, such as the ability to synthesize starch in both plastids and cytosol and the synthesis of lignin from both phenylalanine and tyrosine. However, the evolutionary origin of these traits has been unclear. Takeda-Kimura et al. sequenced the genomes from grass sister clades and found that although some cytosolic starch synthesis genes emerged within grasses, a key plastid membrane transporter predates their evolution. An earlier tandem duplication event predating a grass-specific whole-genome duplication gave rise to the bifunctional phenylalanine/tyrosine ammonia lyase, enabling dual lignin biosynthesis in grasses.

TGW1a locus simultaneously shortens growth duration and boosts grain yield in rice

水稻TGW1a位点同时缩短生育期并提高籽粒产量

▲ 作者：ZHIYONG LI, GUAN LI, ZHICHAO LIU, ZHEN CHENG, YIBO WU, XIXI LIU, XINYONG LIU, XIN AI, WANNING LIU, AND JIAN ZHANG, etc.

▲ 链接：

<https://www.science.org/doi/10.1126/science.ady1619>

▲ 摘要：

现代耕作制度中，每年种植多季作物，要求每季作物的生育期更短。然而，这种缩短的生育期往

往导致产量降低。研究者利用开花期和籽粒产量具有显著差异的水稻种质资源，鉴定出一个与早开花和增大籽粒相关的遗传位点。

该位点下的基因编码一种类似成花素的蛋白质。通过将该蛋白质与一个控制籽粒数量的不利等位基因解偶联，研究者将两个有利等位基因组合在一起，从而在缩短生育期的同时实现了更高的籽粒产量。

▲ Abstract :

Modern cropping systems with multiple crops grown per year demand shorter growing periods per crop. However, these condensed crop durations often lead to lower yield. Using rice accessions with contrasting flowering time and grain yield, Li et al. identified a genetic locus associated with earlier flowering time and increased grain size. The underlying gene encodes a florigen-like protein. By decoupling this protein from a detrimental allele that controls grain number, the s combined the two beneficial alleles, resulting in in higher grain yield despite shorter growth duration.

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