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编者按：2021 年不仅是“十四五”的开局之年，也是两个百年目标交汇与转换之年。为了让我校师生快速了解国内外学术前沿、经典及热点，图书馆学科服务团队特开辟此栏目，利用 WOS/ESI/Incites、Scopus/SciVal 等权威数据库和分析工具筛选研究前沿，或跟踪重要学术网站获取最新学术动态，分专题进行编译报道。因学科专业所限，难免出错，敬请批评指正。同时，我们也面向全校师生征集关注的领域和专题。

本期推荐报道 Nature、Science 期刊上材料科学领域的最新论文。

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美国 Science（《科学》）、英国 Nature（《自然》）及美国 Cell（《细胞》）是国际公认的三大享有最高学术声誉的科技期刊，发表在这三大期刊上的论文简称 CNS 论文。本次精选 2021 年 6 月 Science 和 Nature 中的部分材料科学领域论文，详细情况如下。

材料科学 6 月 Science 论文

[1] Stacking-engineered ferroelectricity in bilayer boron nitride

双层氮化硼的堆叠工程铁电性

出版信息：Science, 25 JUNE 2021, VOL 372, ISSUE 6549

作者：Kenji Yasuda, Xirui Wang, Kenji Watanabe, Takashi Taniguchi, Pablo Jarillo-Herrero.

第一作者单位：Department of Physics, Massachusetts Institute of Technology, Cambridge, MA 02139, USA.

全文链接：https://science.sciencemag.org/content/372/6549/1458

Abstract：Two-dimensional (2D) ferroelectrics with robust polarization down to atomic thicknesses provide building blocks for functional heterostructures. Experimental realization remains challenging because of the requirement of a layered polar crystal. Here, we demonstrate a rational design approach to engineering 2D ferroelectrics from a nonferroelectric parent compound by using van der Waals assembly. Parallel-stacked bilayer boron nitride exhibits out-of-plane electric polarization that reverses depending on the stacking order. The polarization switching is probed through the resistance of an adjacently stacked graphene sheet. Twisting the boron nitride sheets by a small angle changes the dynamics of switching because of the formation of moiré ferroelectricity with staggered polarization. The ferroelectricity persists to room temperature while keeping the high mobility of graphene, paving the way for potential ultrathin nonvolatile memory applications.

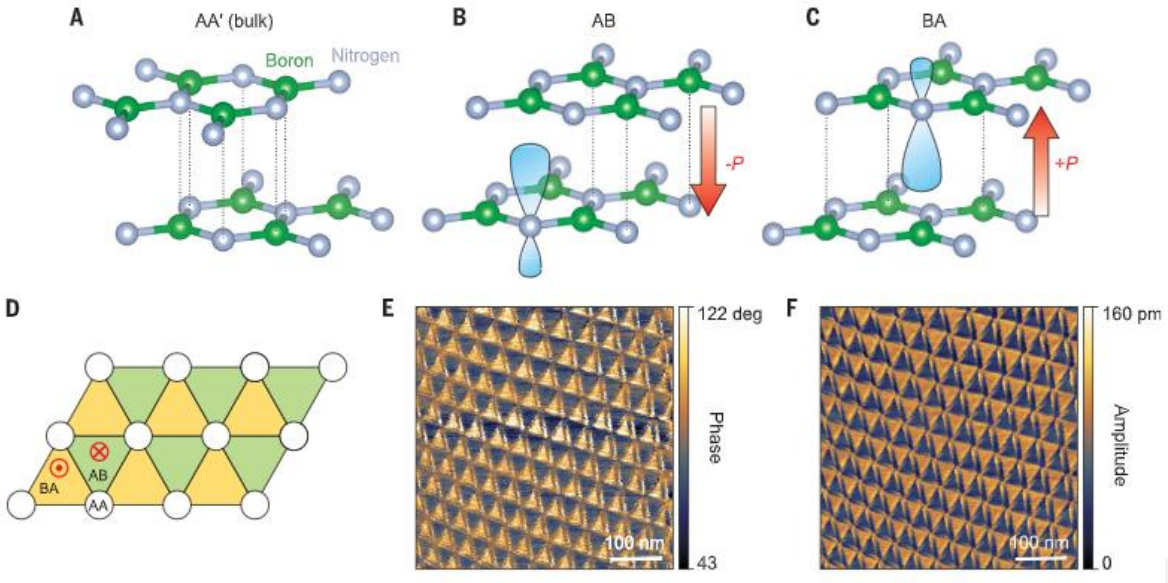
摘要翻译：二维（2D）铁电体具有稳健极化强度，可达到原子厚度，为功能异质结构提供了基础。由于需要层状极性晶体，实验实现仍然具有挑战性。

研究组展示了一个从非铁电母体化合物通过使用范德华组装工程二维铁电体的合理设计方法。平行堆叠的双层氮化硼表现出面外电极化，并随堆叠顺序发生反转。

通过相邻堆叠的石墨烯片的电阻来探测极化转换。由于形成了交错极化的莫尔铁电体，将氮化硼片扭转小角度即可改变转换动力学。

这种铁电性在保持石墨烯高迁移率的同时可持续至室温，为超薄非易失性存储器的潜在应用奠定了基础。

文中插图：



[2] Interfacial ferroelectricity by van der Waals sliding

范德华滑动的界面铁电性

出版信息：Science, 25 JUNE 2021, VOL 372, ISSUE 6549

作者：M. Vizner Stern, Y. Waschitz, W. Cao, I. Nevo, K. Watanabe, T. Taniguchi, et al.

第一作者单位：School of Physics and Astronomy, Tel Aviv University, Israel.

全文链接：https://science.sciencemag.org/content/372/6549/1462

Abstract：Despite their partial ionic nature, many-layered diatomic crystals avoid internal electric polarization by forming a centrosymmetric lattice at their optimal van der Waals stacking. Here, we report a stable ferroelectric order emerging at the interface between two naturally grown flakes of hexagonal boron nitride, which are stacked together in a metastable non-centrosymmetric parallel orientation. We observe alternating domains of inverted normal polarization, caused by a lateral shift of one lattice site between the domains. Reversible polarization switching coupled to lateral sliding is achieved by scanning a biased tip above the surface. Our calculations trace the origin of the phenomenon to a subtle interplay between charge redistribution and ionic displacement and provide intuitive insights to explore the interfacial polarization and its distinctive “slidetronics” switching mechanism.

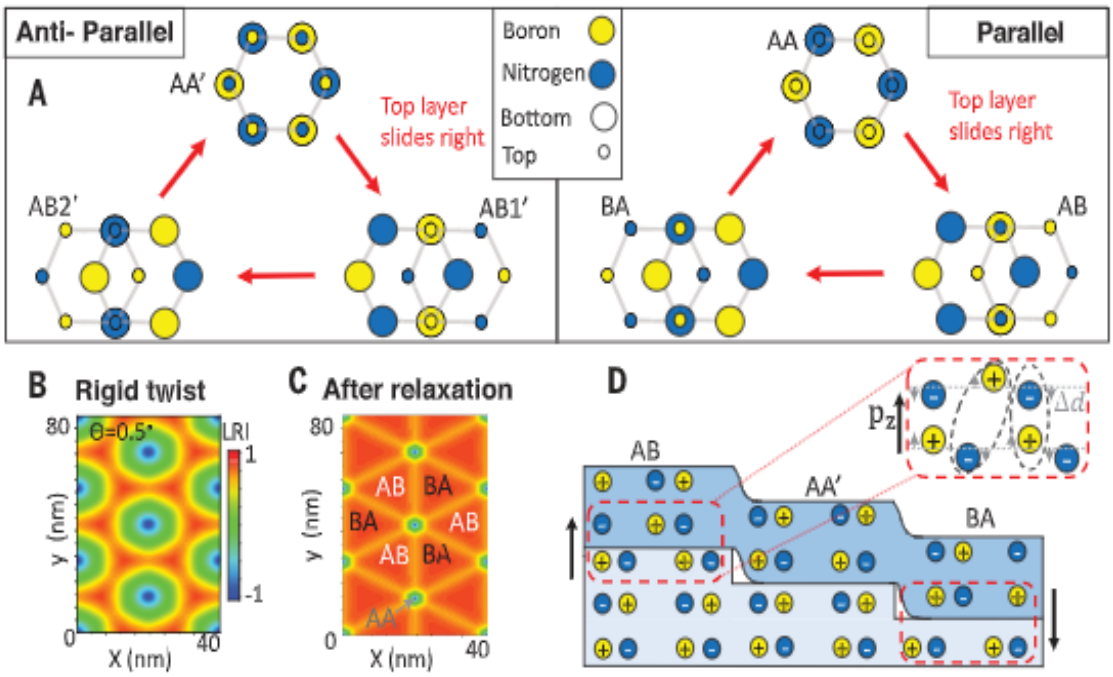
摘要翻译：虽然有部分离子性质，但许多层状双原子晶体通过在其最佳范德华堆叠处形成中心对称晶格来避免内部电极化。

研究组报告了出现在两个自然生长的六方氮化硼片之间的稳定铁电有序，在亚稳非中心对称平行方向堆叠在一起。

他们观察到反向常规极化的交替域，这是由域之间一个晶格位的横向移动引起的。通过扫描表面上方的偏压尖端，实现了与横向滑动耦合的可逆极化转换。

研究组的计算将这种现象的起源追溯到电荷再分配和离子位移之间的微妙相互作用，并为探索界面极化及其独特的“滑动电子学”转换机制提供了直观见解。

文中插图：



[3] Pressure-driven fusion of amorphous particles into integrated monoliths

压力驱动无定形颗粒融合为完整块体

出版信息：Science, 25 JUNE 2021, VOL 372, ISSUE 6549

作者：Zhao Mu, Kangren Kong, Kai Jiang, Hongliang Dong, Xurong Xu, Zhaoming Liu, et al.

第一作者单位：Department of Chemistry, Zhejiang University, Hangzhou 310027, China.

国内相关报道：http://www.news.zju.edu.cn/2021/0625/c23225a2399010/page.htm

全文链接：https://science.sciencemag.org/content/372/6549/1466

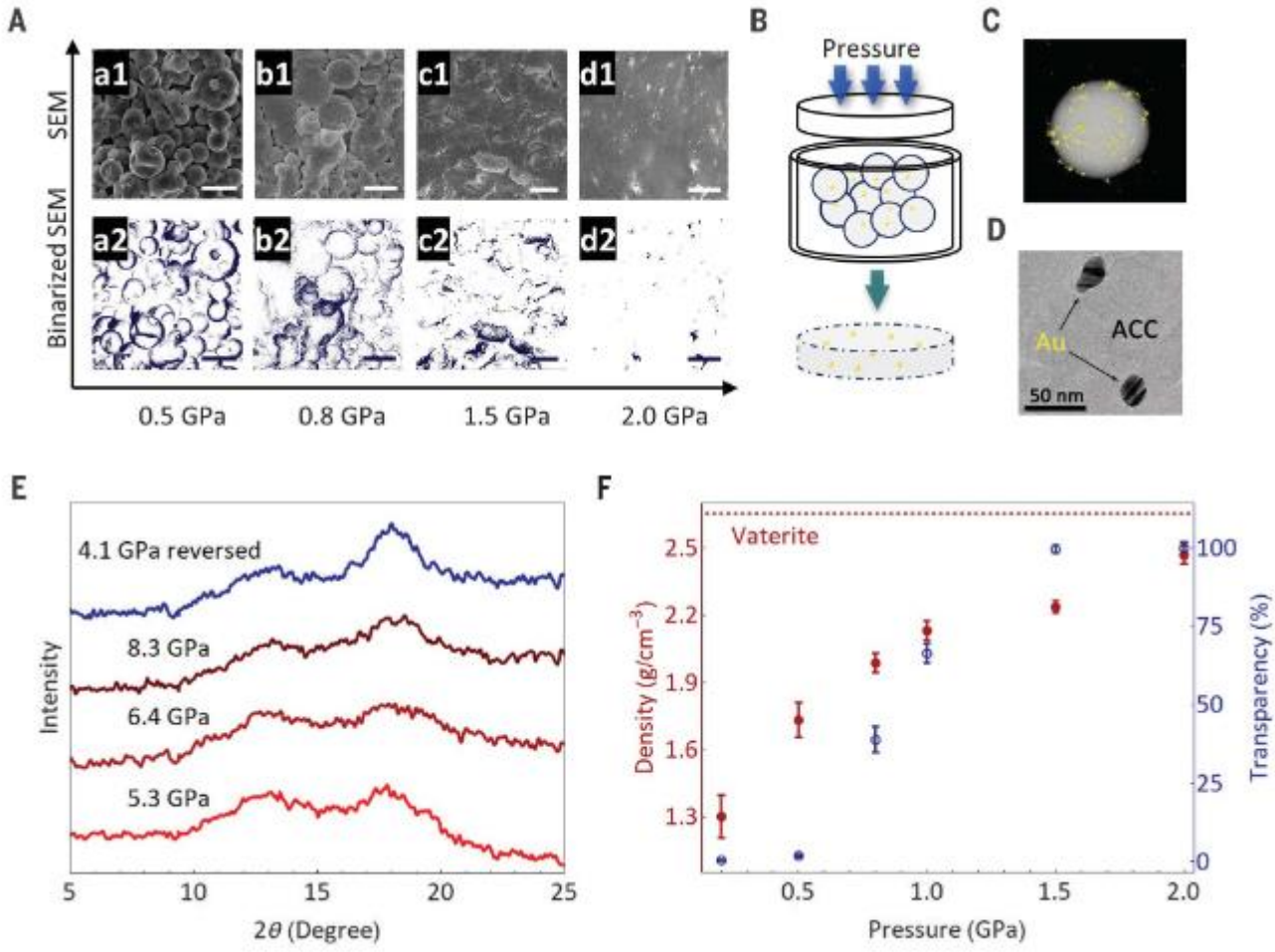
Abstract：Biological organisms can use amorphous precursors to produce inorganic skeletons with continuous structures through complete particle fusion. Synthesizing monoliths is much more difficult because sintering techniques can destroy continuity and limit mechanical strength. We manufactured inorganic monoliths of amorphous calcium carbonate by the fusion of particles while regulating structurally bound water and external pressure. Our monoliths are transparent, owing to their structural continuity, with a mechanical strength approaching that of single-crystal calcite. Dynamic water channels within the amorphous bulk are synergistically controlled by water content and applied pressure and promote mass transportation for particle fusion. Our strategy provides an alternative to traditional sintering methods that should be attractive for constructing monoliths of temperature-sensitive biominerals and biomaterials.

摘要翻译：生物有机体可以利用无定形前体，通过完全的颗粒融合，产生具有连续结构的无机骨架。由于烧结技术会破坏连续性并限制机械强度，合成块体要困难得多。

研究组在调节结构结合水和外部压力的同时，通过颗粒融合制备了无定形碳酸钙无机块体。该块体是透明的，由于其结构的连续性，机械强度接近单晶方解石。非晶体内部的动态水通道受水含量和外部压力协同控制，促进颗粒融合的质量传递。

研究组提供了一种替代传统烧结方法的策略，将助力于构建温度敏感的生物矿物和生物材料块体。

文中插图：



[4] Resolving multifrequential oscillations and nanoscale interfacet communication in single-particle catalysis

单粒子催化中多频振荡的解析与纳米级界面通讯

出版信息: Science, 18 JUNE 2021, VOL 372, ISSUE 6548

作者： Y. Suchorski, J. Zeininger, S. Buhr, M. Raab, M. Stöger-Pollach, et al.、

第一作者单位： Institute of Materials Chemistry, TU Wien, Getreidemarkt 9, 1060 Vienna, Austria.

全文链接： https://science.sciencemag.org/content/372/6548/1314

Abstract： In heterogeneous catalysis research, the reactivity of individual nanofacets of single particles is typically not resolved. We applied in situ field electron microscopy to the apex of a curved rhodium crystal (radius of 650 nanometers), providing high spatial (~2 nanometers) and time resolution (~2 milliseconds) of oscillatory catalytic hydrogen oxidation, to image adsorbed species and reaction fronts on the individual facets. Using ionized water as the imaging species, the active sites were directly imaged with field ion microscopy. The catalytic behavior of differently structured nanofacets and the extent of coupling between them were monitored individually. We observed limited interfacet coupling, entrainment, frequency locking, and reconstruction-induced collapse of spatial coupling. The experimental results are backed up by microkinetic modeling of time-dependent oxygen species coverages and oscillation frequencies.

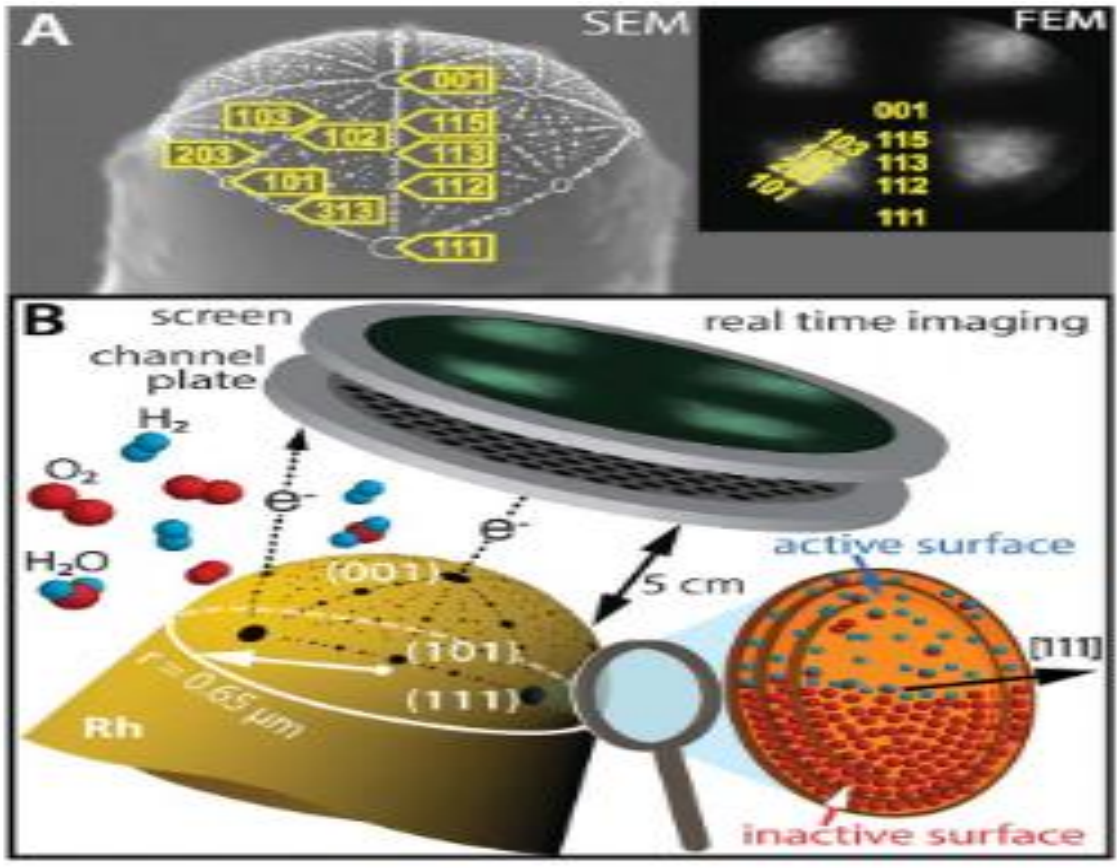
摘要翻译： 在多相催化研究中，单个粒子的单个纳米面的反应性通常是不可分辨的。

我们将原位场发射电子显微镜应用于弯曲铑晶体（半径为 650 纳米）的顶端，提供了振荡催化氢氧化的高空间分辨率（~2 纳米）和时间分辨率（~2 毫秒），对单个面上的吸附物种和反应前沿进行了成像。

以离子水为成像物质，用场离子显微镜对活性部位进行直接成像。我们分别监测了不同结构的纳米晶面的催化行为和它们之间的耦合程度。

我们观察到有限的面间耦合、夹带、频率锁定和重构引起的空间耦合崩溃。实验结果得到了随时间变化的氧物种覆盖度和振荡频率的微动力学模型的支持。

文中插图：



[5] Tough hydrogels with rapid self-reinforcement

可快速自我强化的坚韧水凝胶

出版信息：Science, 04 JUNE 2021, VOL 372, ISSUE 6546

作者：Chang Liu, Naoya Morimoto, Lan Jiang, Sohei Kawahara, Takako Noritomi, Hideaki Yokoyama, et al.

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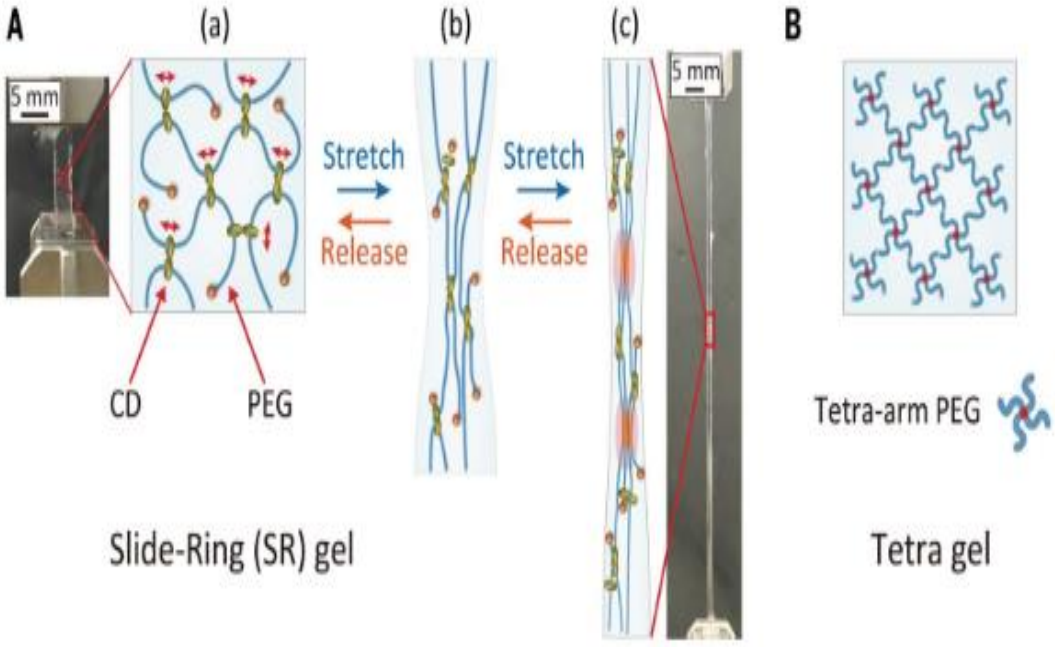
全文链接：https://science.sciencemag.org/content/372/6546/1078

Abstract： Most tough hydrogels are reinforced by introducing sacrificial structures that can dissipate input energy. However, because the sacrificial damage cannot rapidly recover, the toughness of these gels drops substantially during consecutive cyclic loadings. We propose a damageless reinforcement strategy for hydrogels using strain-induced crystallization. For slide-ring gels in which polyethylene glycol chains are highly oriented and mutually exposed under large deformation, crystallinity forms and melts with elongation and retraction, resulting both in almost 100% rapid recovery of extension energy and excellent toughness of 6.6 to 22 megajoules per square meter, which is one order of magnitude larger than the toughness of covalently cross-linked homogeneous gels of polyethylene.

摘要翻译：大多数坚韧的水凝胶通过引入能够耗散输入能量的牺牲结构来增强。然而，由于牺牲损伤不能迅速恢复，这些凝胶的韧性在连续循环加载过程中大幅下降。

研究组提出了一种基于应变诱导结晶的水凝胶无损伤增强策略。对于聚乙二醇链高度取向并在大变形下相互暴露的滑动交联凝胶，结晶度形成并随着拉伸和收缩而软化，导致拉伸能几乎 100%地快速恢复，以及 6.6-22 MJ/m2 的优良韧性，这比聚乙二醇共价交联均质凝胶的韧性大一个数量级。

文中插图：



[1]Fizeau drag in graphene plasmonics

菲索拖曳石墨烯等离子体

出版信息：Nature, 24 June 2021 , Volume 594 Issue 7864

作者：Y. Dong, L. Xiong, I. Y. Phinney, Z. Sun, R. Jing, A. S. McLeod, S. Zhang, S. Liu, F. L. Ruta, H. Gao, Z. Dong, R. Pan, J. H. Edgar, P. Jarillo-Herrero, L. S. Levitov, A. J. Millis, M. M. Fogler, D. A. Bandurin & D. N. Basov

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全文链接：https://www.nature.com/articles/s41586-021-03640-x

Abstract：Dragging of light by moving media was predicted by Fresnel and verified by Fizeau’s celebrated experiments with flowing water. This momentous discovery is among the experimental cornerstones of Einstein’s special relativity theory and is well understood in the context of relativistic kinematics. By contrast, experiments on dragging photons by an electron flow in solids are riddled with inconsistencies and have so far eluded agreement with the theory. Here we report on the electron flow dragging surface plasmon polaritons (SPPs): hybrid quasiparticles of infrared photons and electrons in graphene. The drag is visualized directly through infrared nano-imaging of propagating plasmonic waves in the presence of a high-density current. The polaritons in graphene shorten their wavelength when propagating against the drifting carriers. Unlike the Fizeau effect for light, the SPP drag by electrical currents defies explanation by simple kinematics and is linked to the nonlinear electrodynamics of Dirac electrons in graphene. The observed plasmonic Fizeau drag enables breaking of time-reversal symmetry and reciprocity at infrared frequencies without resorting to magnetic fields or chiral optical pumping. The Fizeau drag also provides a tool with which to study interactions and nonequilibrium effects in electron liquids.

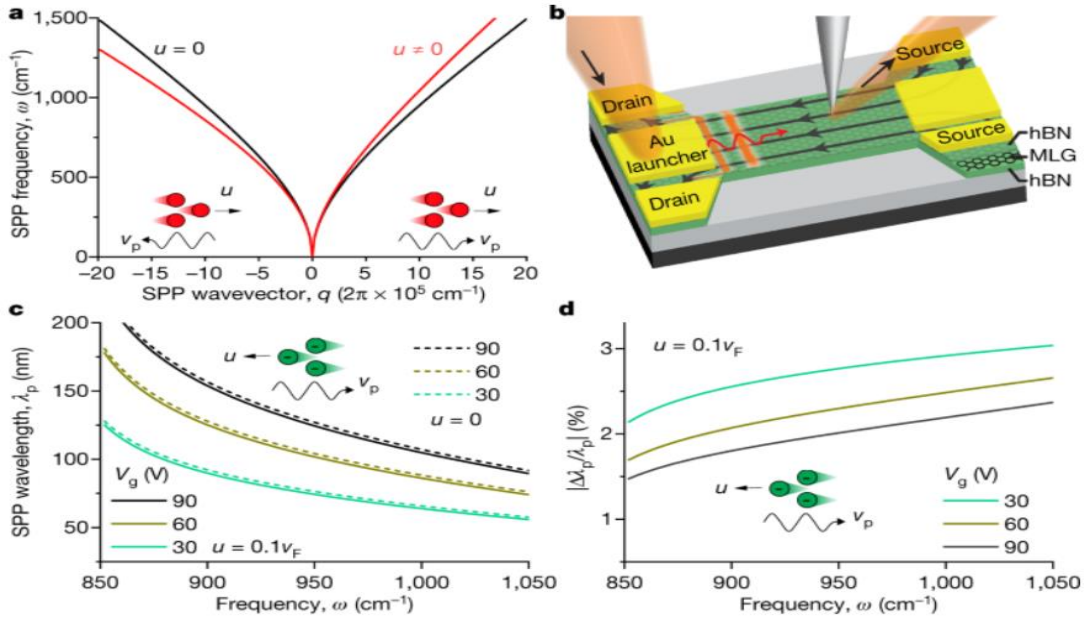
Efficient Fizeau drag from Dirac electrons in monolayer graphene

摘要翻译：菲涅耳预测了移动介质对光的拖曳作用，菲索著名的流水实验证实了这一点。这一重大发现是爱因斯坦狭义相对论的实验基石之一，并在相对论运动学的背景下得到了很好的理解。相比之下，关于电子流在固体中拖曳光子的实验充满了不一致性，到目前为止还未能与该理论达成一致。

作者报道了石墨烯中红外光子和电子的混合准粒子——表面等离子体激元（SPPs）的电子流拖曳。阻力是直接可视化的红外纳米成像传播等离子体波存在高密度电流。石墨烯中的极化子对着漂移载流子传播时，其波长会缩短。与光的菲索效应不同，由电流产生的 SPP 拖拽无法用简单的运动学解释，它与石墨烯中狄拉克电子的非线性电动力学有关。

他们表示，观测到的等离子体菲索拖拽使红外频率上的时间反转对称性和互易性得以打破，而无需借助磁场或手性光泵浦。菲索阻力也为研究电子液体中的相互作用和非平衡效应提供了一个工具。

文中插图：



[2]Efficient Fizeau drag from Dirac electrons in monolayer graphene

单层石墨烯中狄拉克电子的有效菲索阻力

出版信息：Nature, 24 June 2021 , Volume 594 Issue 7864

作者：Wenyu Zhao, Sihan Zhao, Hongyuan Li, Sheng Wang, Shaoxin Wang, M. Iqbal Bakti Utama, Salman Kahn, Yue Jiang, Xiao Xiao, SeokJae Yoo, Kenji Watanabe, Takashi Taniguchi, Alex Zettl & Feng Wang

第一作者单位：Department of Physics, University of California, Berkeley, Berkeley, CA, USA

全文链接：https://www.nature.com/articles/s41586-021-03574-4

Abstract： Fizeau demonstrated in 1850 that the speed of light can be modified when it is propagating in moving media. However, such control of the light speed has not been achieved efficiently with a fast-moving electron media by passing an electrical current. Here we report direct observation of Fizeau drag of plasmon polaritons in strongly biased monolayer graphene by exploiting the high electron mobility and the slow plasmon propagation of massless Dirac electrons. The large bias current in graphene creates a fast-drifting Dirac electron medium hosting the plasmon polariton. This results in non-reciprocal plasmon propagation, where plasmons moving with the drifting electron media propagate at an enhanced speed. We measure the Doppler-shifted plasmon wavelength using cryogenic near-field infrared nanoscopy, which directly images the plasmon polariton mode in the biased graphene at low temperature. We observe a plasmon wavelength difference of up to 3.6 per cent between a plasmon moving with and a plasmon moving against the drifting electron media. Our findings on the plasmonic Doppler effect provide opportunities for electrical control of non-reciprocal surface plasmon polaritons in non-equilibrium systems.

摘要翻译：菲索在 1850 年证明了光在运动介质中传播时的速度是可以改变的。然而，这种对光速的控制并没有在快速移动的电子介质中通过电流来有效地实现。本文报道了利用无质量狄拉克电子的高电子迁移率和缓慢的等离子体传播，直接观察到强偏置单层石墨烯中等离子体激元的菲索拖动。石墨烯中的大偏置电流产生了一个快速漂移的狄拉克电子介质，容纳了等离子激元。这导致了非互反的等离子体传播，等离子体与漂移的电子介质一起以增强的速度传播。

作者利用低温近场红外纳米技术测量多普勒位移等离子体波长，直接成像偏置石墨烯中的等离子体激元模式。他们观察到与漂移电子介质一起运动的等离子体和与漂移电子介质对抗运动的等离子体之间的等离子体波长差异高达 3.6%。作者在等离子体多普勒效应上的发现，为非平衡系统中非互反表面等离子体激元的电气控制提供了机会。

文中插图：