2D Straintronic Devices

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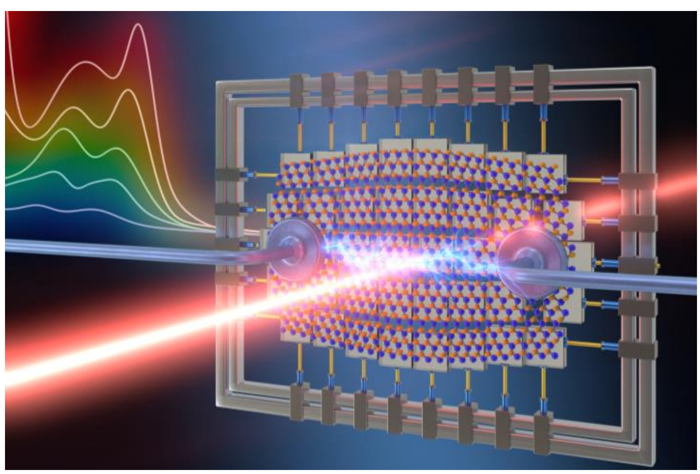
Graphical Abstract



Abstract

Strain engineering is an interesting strategy to tune a material's electronic properties by subjecting its lattice to a mechanical deformation. Conventional straining approaches, used for 3D materials (including epitaxial growth on a substrate with a lattice parameter mis-match, the use of a dielectric capping layer or heavy ions implantation) are typically limited to strains lower than 2% in most cases due to the low maximum strains sustained by brittle bulk semiconducting materials. Bulk silicon, for example, can be strained only up to 1.5% before breaking. Moreover, these straining approaches induce static deformations of the semiconductor materials and therefore they are not suitable for tunable functional devices. 2D materials, on the other hand, can be literally stretched, folded, bent or even pierced standing remarkably large deformation before rupture [**1**]. This outstanding stretchability (and the possibility of using dynamically varying strain) of 2D materials promises to revolutionize the field of strain engineering and could lead to "straintronic" devices – devices with electronic and optical properties that are engineered through the introduction of

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mechanical deformations. In this talk I will discuss our recent efforts to study strain engineering in 2D materials and to exploit it to fabricate strain tunable functional optoelectronic devices [**2-7**].

Keywords: Straintronics; strain engineering; optoelectronics; molybdenum disulfide (MoS_2); 2D materials.

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Biography of Presenting Author

Andres Castellanos-Gomez is a Tenured Scientist in the Spanish National Research Council (Consejo Superior de Investigaciones Científicas, CSIC). He graduated in Physics in the Universidad Complutense of Madrid (Spain) in 2006 and got his PhD by the Autonoma University of Madrid (Spain) with Cum-Laude and Extraordinary Award. From 2011 till 2015 he was a post-doctoral researcher at the Kavli Institute of Nanoscience in the group of Prof. van der Zant where he got a Marie Curie Fellowship. In 2015 he got a Tenure Track position at the IMDEA Nanoscience Research Institute of Madrid and in 2017 he got his actual Tenured Scientist position at CSIC. He explores novel 2D materials and studies their mechanical, electrical and optical properties with special interest on the application of these materials in nanomechanical and optoelectronic devices. He authored ~140 articles in international peer review journals and 6 book chapters. According to Google Scholar, A. Castellanos-Gomez has an h-index of 50, with a total number of citations above 13,000. He was awarded an ERC Starting Grant in 2017 and has been selected as Emerging Leader 2020 by Journal of Physics: Materials, included in the Highly Cited Researchers 2018 and 2019 lists of Clarivate/WOS, selected as one of the 2018 Emerging Investigators by Chemical Society Reviews and selected as one of the Top Ten Spanish Talents of 2017 by the MIT Technology Reviews. He has been also recognized with the Young Researcher Award (experimental physics) of the Royal Physical Society of Spain (2016).

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