DEPARTAMENTO DE FÍSICA FUNDAMENTAL

Straintronics in 2D materials

Andrés Castellanos-Gómez

[1] *Materials Science Factory, Instituto de Ciencia de Materiales de Madrid (ICMM-CSIC), Madrid E-28049, Spain.*

Email: Andres.castellanos@csic.es

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 can be literally stretched, folded, bent or even pierced. [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 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]

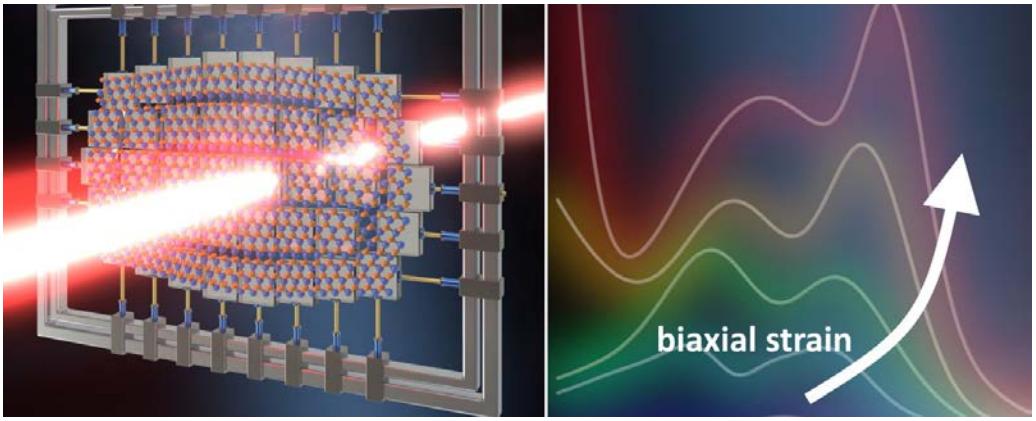

Figure 1. (left) artistic representation of a single-layer MoS2 photodetector subjected to biaxial strain. (right) photocurrent spectra acquired at increasingly high biaxial strain.

[1] R Roldán et al. Journal of Physics: Condensed Matter (2015) 27 (31), 313201
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[3] J Quereda, et al. Nano letters (2016) 16 (5), 2931-2937
[4] JO Island, et al. Nanoscale (2016) 8 (5), 2589-2593
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[6] R Frisenda, et al. npj 2D Materials and Applications (2017) 1 (1), 10
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