

GDR HOWDI 2022 MEETING: STRAIN SWITCHING IN VAN DER WAALS HETEROSTRUCTURES BY INCORPORATING SPIN-CROSSOVER MATERIALS

Carla Boix-Constant¹, Víctor García-López¹, Efrén Navarro-Moratalla¹, Miguel Clemente-León¹, José Luis Zafra², Juan Casado², Francisco Guinea³, Samuel Mañas-Valero¹, Eugenio Coronado¹.

¹Instituto de Ciencia Molecular (ICMol), Universitat de València, Paterna, 46980, SPAIN.

²Department of Physical Chemistry, Universidad de Málaga, Málaga, 29071, SPAIN.

³Instituto Madrileño de Estudios Avanzados en Nanociencia (IMDEA - Nanociencia), Madrid, 28049, SPAIN.

Van der Waals heterostructures (vdWHs) provide the possibility of engineering new materials with emergent functionalities that are not accessible in another way. These heterostructures are formed by assembling layers of different materials used as building blocks. Beyond inorganic 2D crystals, layered molecular materials remain still rather unexplored, with only few examples regarding their isolation as atomically thin layers. In this work, the family of van der Waals heterostructures is enlarged by introducing a molecular building block able to produce strain: the spin-crossover (SCO). In these metal-organic materials, a spin transition can be induced by applying external stimuli like light, temperature, pressure, or an electric field. In particular, smart vdWHs are prepared in which the electronic and optical properties of the 2D material (graphene and WSe₂) are clearly switched by the strain caused by the spin transition. These molecular/inorganic vdWHs represent the deterministic incorporation of bistable molecular layers with other 2D crystals of interest in the emergent fields of straintronics and band engineering in low-dimensional materials.

References

[1] Boix-Constant, Carla *et al.*, *Adv. Mater.* 2022, 2110027.

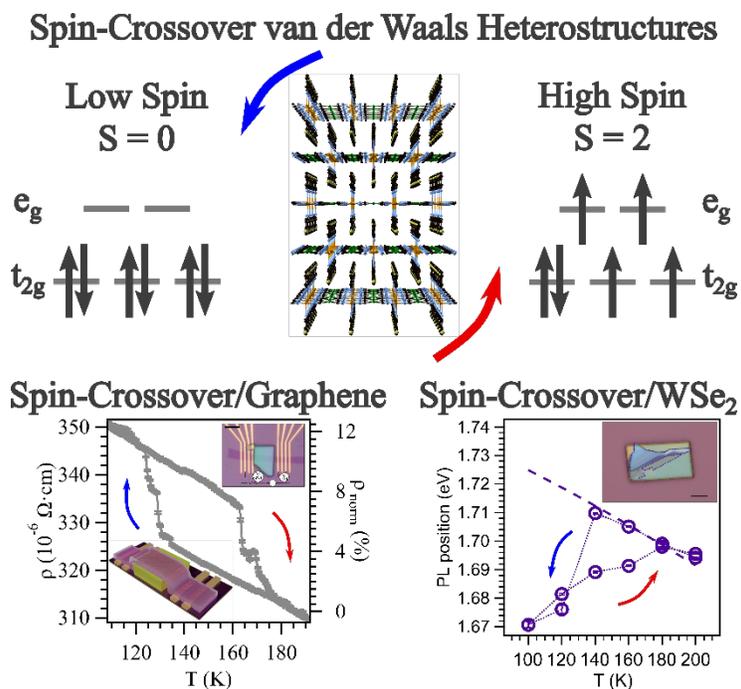


Figure 1. Upper figure: Scheme of the spin-crossover phenomenon for a d^6 (Fe^{2+}) metal complex. Bottom left: Thermal dependence of the resistivity for a vdWH. Bottom right: Thermal dependence of the PL position for the vdWH and a reference WSe₂ monolayer.