Inducing strain in two-dimensional materials with spin-crossover metal-organic frameworks.

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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. 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. In particular, smart vdWHs are prepared in which the electronic and optical properties of the 2D material (graphene, WSe_2) are switched by the strain caused by the spin transition. These hybrid vdWHs represent the deterministic incorporation of bistable molecular layers with other 2D crystals in the emergent fields of straintronics and band engineering in low-dimensional materials.

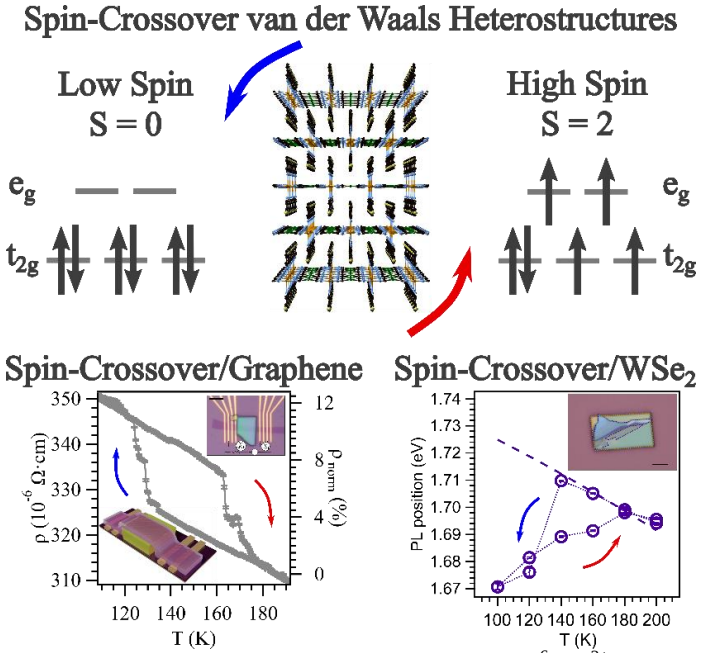

Fig. 1. Upper figure: Scheme of the spin-crossover phenomenon for a d^6 (Fe^{2+}) metal complex. Bottom left: Thermal dependence of the resistivity for a vdWH. Bottom right: Thermal dependence of the PL position for the vdWH and a reference WSe_2 monolayer.

References

[1] Boix-Constant, Carla *et.al*, *Adv. Mater.* **34**, 2110027 (2022).