Twistronics in 2D magnetic heterostructures

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Abstract

The controlled assembly of 2D materials in van der Waals heterostructures provides the opportunity to design unconventional materials with novel properties. Here I will illustrate this concept in artificial magnets obtained by creating a twisted 2D heterostructure formed by two ferromagnetic monolayers of CrSBr twisted by an angle of 90º [1]. Magneto-transport measurements in this new material show a multistep spin switching with the opening of hysteresis, which is absent in the pristine bilayer case (angle of 0º) [2], as a consequence of the competition between the inter-layer exchange interactions (which favour an antiparallel orientation of both spin layers), the local spin anisotropies (which tend to orient the spins along the easy axis of each monolayer, x and y) and an external magnetic field applied along one of these easy axes. This spin-twistronics concept is extended to more complex twisted heterostructures, as for example the bilayer/bilayer case and the monolayer/bilayer one, and the potential use of these ultrathin magnetic heterostructures in spintronics is discussed.

References

[1] C. Boix-Constant *et al.*, Nat. Mater., 23 (2024) 212-218
[2] C. Boix-Constant *et al.,* Adv. Mater., 34 (2022) 2204940