Materials Research Science and Engineering Centers

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Twisted bilayer Moiré magnets

Better magnetic memory storage technology will require materials with nanoscale magnetic textures to store information at the highest possible density. There is a unique opportunity to create magnetic textures that do not exist in natural materials, by assembling two layers of two-dimensional (2D) materials with a twist between their crystal axes. The interference between the atomic structures in adjacent layers produces a periodic Moiré pattern. Making use of the Moiré pattern in twisted 2D ferromagnetic semiconductors, Cornell researchers have created a magnetic pattern that consists of alternating ferromagnetic (FM) and antiferromagnetic (AF) bits on the 10-nm scale. Like an array of nanometer-sized compass needles, in the FM domains, the magnetic moments of the atoms are aligned, and in the AF domains the moments of alternating atoms point in opposite directions. The research may find applications in voltage-controlled high-density magnetic memory storage.

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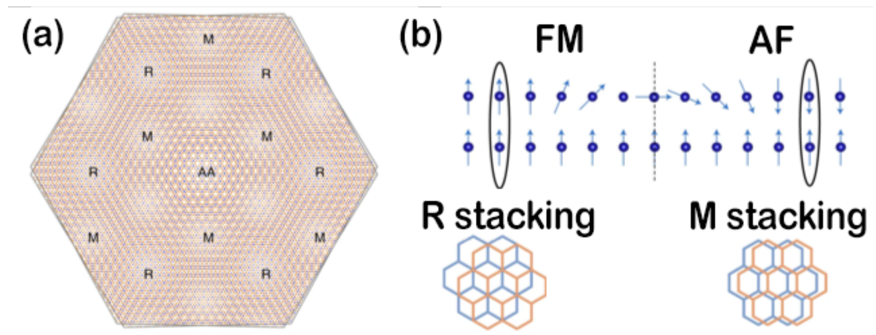

a) Moiré pattern of two CrI_3 layers with a twist angle between them. A single layer of CrI_3 is a ferromagnetic semiconductor. R and M denote rhombohedral and monoclinic stacking of the atoms in the indicated regions. b) Illustration of a magnetic domain wall formed between the R- and M-stacking regions. Balls and arrows denote atoms and their magnetic moments. Blue and orange denote the adjacent CrI_3 layers. Because the magnetic interactions depend on the stacking structure, a magnetic moiré pattern is formed.

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