Unprecedented spin properties revealed in new artificial materials

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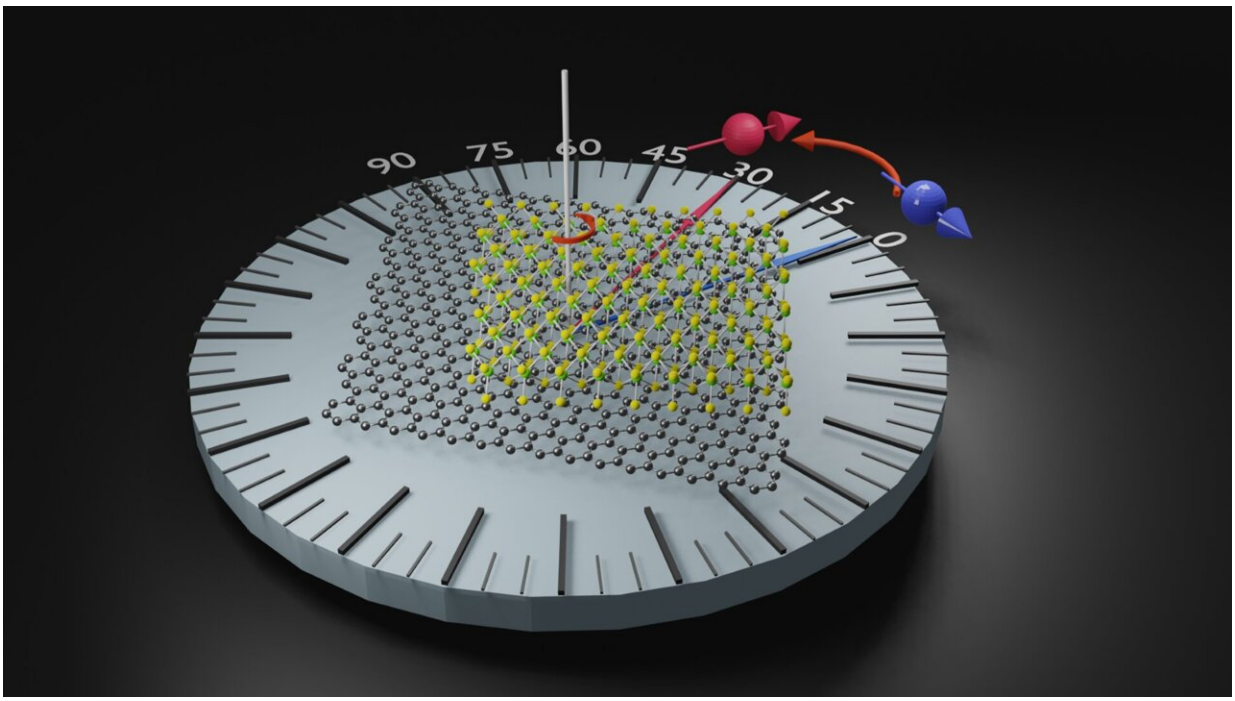

Credit: Elhuyar Fundazioa

In conjunction with research staff from the Charles University of Prague and the CFM (CSIC-UPV/EHU) center in San Sebastian, CIC nanoGUNE's Nanodevices group has designed a new complex material with emerging properties in the field of spintronics. This discovery, published in the journal *Nature Materials*, opens up a range of fresh possibilities for the development of novel, more efficient and more

advanced electronic devices, such as those that integrate magnetic memories into processors.

The discovery of two-dimensional materials with unique characteristics has led to a boom in research into these materials as new effects are produced when two layers of these materials are stacked to form a heterostructure. It has recently been observed that minute rotations of these layers can significantly change the properties of this heterostructure.

"In this work we studied the stacking of two layers of graphene and tungsten selenide (WSe_2)," explained Ikerbasque Research Professor Félix Casanova, co-leader of the Nanodevices group at nanoGUNE and who led this work. "If the two layers are placed one on top of the other and rotated at a precise angle, a spin current is generated in a desired specific direction," added Casanova.

Spin (one of the properties of electrons and other particles) is normally transferred in a direction perpendicular to the electric current. Handling these spin currents is one of the main limitations of spintronics—electronics that use spin to store, handle and transfer information. However, "this work shows that this limitation in fact disappears when suitable materials are used," said Casanova.

"By simply stacking two layers and applying a 'magic' twist, new spin-related properties that do not exist in the initial materials can be obtained. The more flexibility we have in the choice of materials, the greater the design possibilities are for next-generation devices."

More information: Haozhe Yang et al, Twist-angle-tunable spin texture in WSe_2/graphene van der Waals heterostructures, *Nature Materials* (2024). DOI: 10.1038/s41563-024-01985-y

Provided by Elhuyar Fundazioa