

Researchers realize half-metallicity in A-type antiferromagnets with ferroelectric control

December 23 2020, by Zhang Nannan

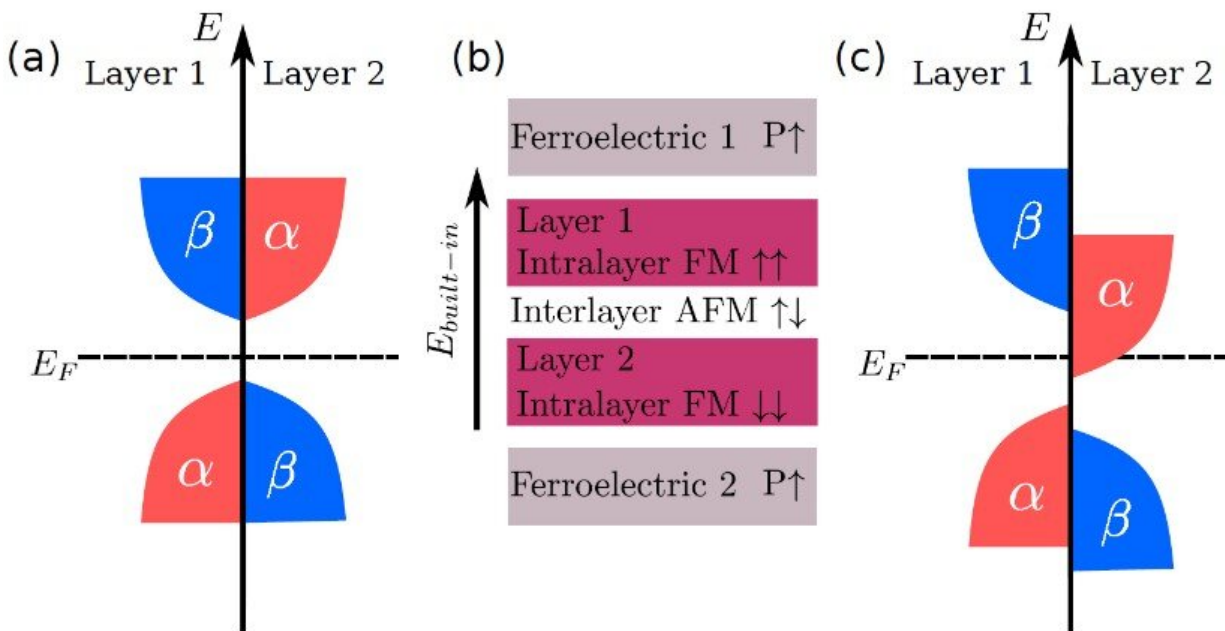


Fig. 1. The schematic illustration of ferroelectric control of half-metallicity in A-type antiferromagnets. Credit: JIANG Peng

Recently, Prof. Zheng Xiaohong's research group from the Institute of Solid State Physics (ISSP) of the Hefei Institutes of Physical Science (HFIPS), in cooperation with Prof. Stefano Sanvito from Trinity College Dublin, demonstrated a novel idea to achieve half-metallicity in A-type van der Waals (vdW) antiferromagnets via ferroelectric control.

Half-[metallicity](#) is an important research topic in condensed matter physics and spintronics. Recently, an interesting class of two-dimensional (2-D) materials, vanadium dichalcogenides exhibiting intrinsic ferromagnetism and high Curie temperature, has been theoretically designed and experimentally synthesized. However, the required critical electric field for achieving half-metallicity is so high that it is almost unavailable under present conditions.

This time, the team reported a vdW multiferroic heterostructure, which was formed by sandwiching the bilayer ${}^2\text{H-VSe}_2$ between two layers of 2-D out-of-plane ferroelectric Sc_2CO_2 , via first-principles simulations.

They found a half-metallic nature presented in the [band structure](#) as well as the conducting spin channel localized in only one [layer](#) of ${}^2\text{H-VSe}_2$.

Meanwhile, the spin polarity and the spatial location would be reversed with the ferroelectric polarization reversal. The [mechanism](#) behind this phenomenon originated from both the built-in electric field of the ferroelectric sandwich, and the charge transfer selectively occurring only at one interface.

Two prototypes of nonvolatile memory devices were therefore further proposed, in which two states ("1" and "0") were realized by switching the polarization direction of the ferroelectric layers.

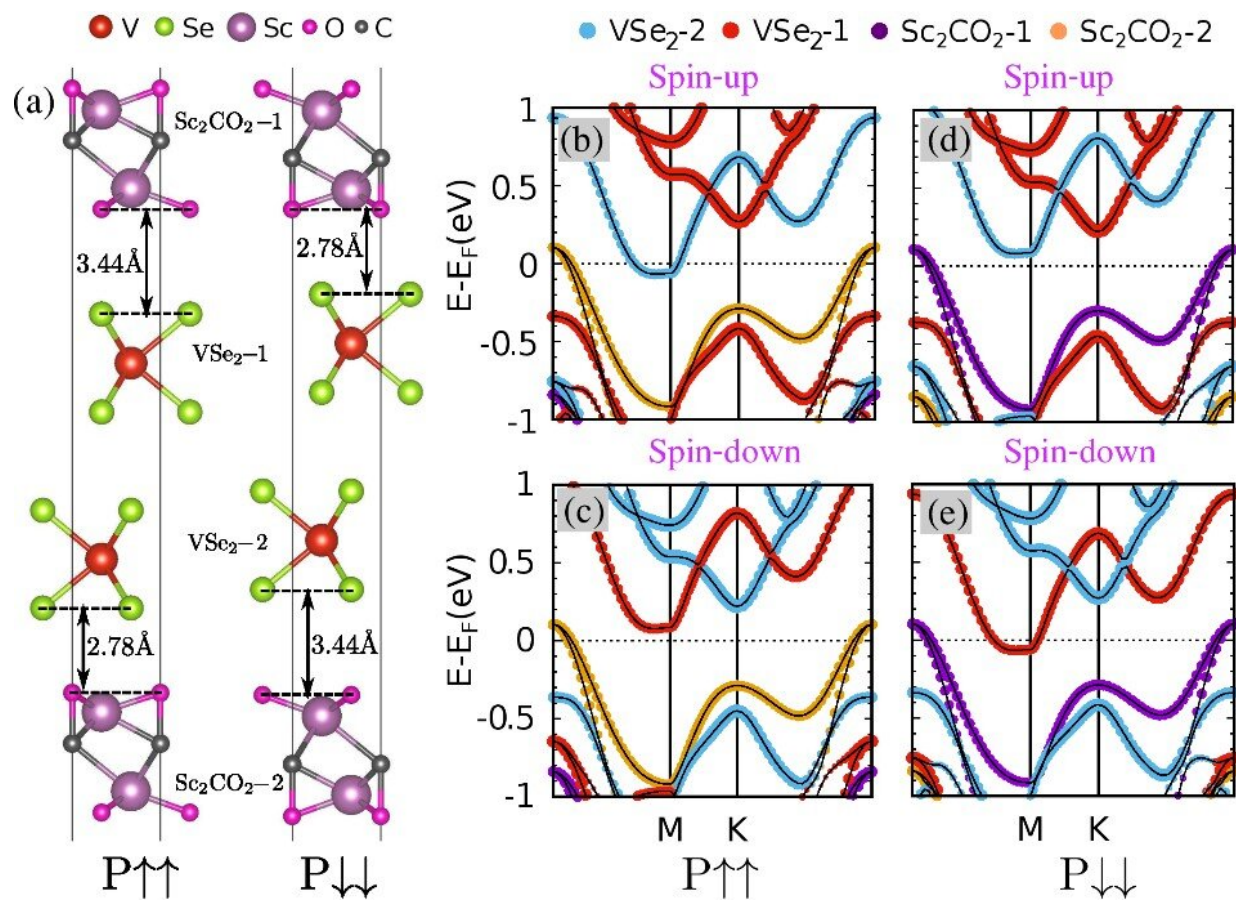


Fig. 2. The atomic structures and the corresponding spin- and layer-resolved band structures of two polarization configurations for the $\text{VSe}_2/\text{Sc}_2\text{CO}_2$ vdW heterostructures. Credit: JIANG Peng

More information: Peng Jiang et al. Ferroelectric control of electron half-metallicity in A -type antiferromagnets and its application to nonvolatile memory devices, *Physical Review B* (2020). DOI: [10.1103/PhysRevB.102.245417](https://doi.org/10.1103/PhysRevB.102.245417)

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