Novel two-dimensional homogeneous bias device induced under moderate pressure

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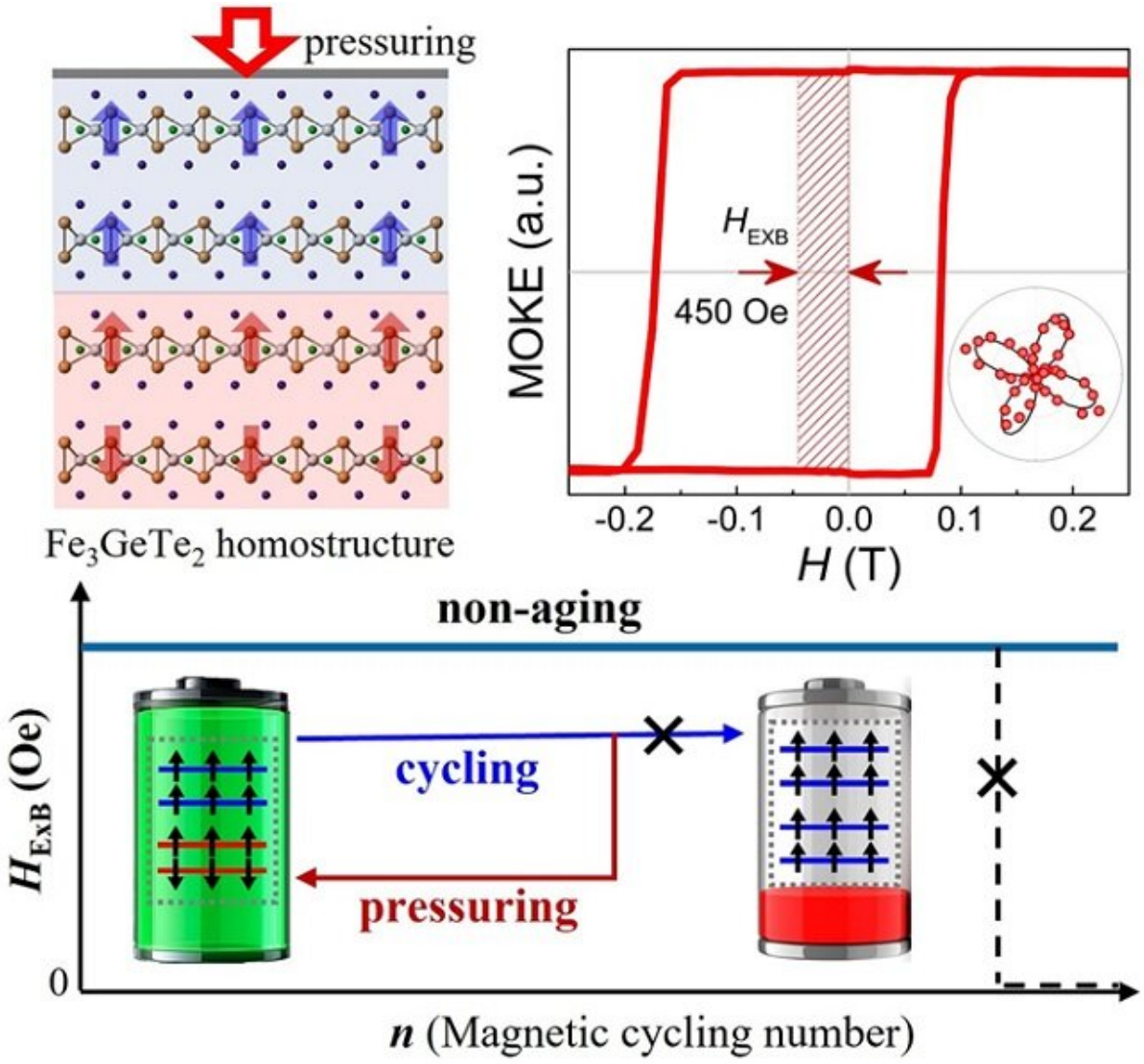

Magnetic transition of Fe3GeTe2 induced by uniaxial compression, magneto-

optical phenomenon of Fe^3GeTe_2 after compression and exchange bias effect of Fe_3GeTe_2 non-aging, extensible and recoverable. Credit: HOU De

In a study published in *Advanced Materials*, researchers from the Hefei Institutes of Physical Science of the Chinese Academy of Sciences in cooperation with researchers from University of Science and Technology of China have developed a new type of two-dimensional homogeneous bias device with moderate pressure.

Compared with similar three-dimensional devices, the two-dimensional bias device was described as "non-aging, extensible and recoverable."

"It provides a new idea for the design of low-dimensional magnetic devices and the study of exchange bias effect mechanism," said Sheng Zhigao, who led the team, "and we expect it to become the core magnetic component in two-dimensional electronic technology and equipment."

Two-dimensional Van der Waals magnetic materials provide an excellent platform for basic magnetic research and low-dimensional magnetic device development due to their layered structure, no dangling bond surface and strong magnetic anisotropy. However, the weak interlayer coupling greatly limits the application of two-dimensional magnetic material functional devices. Therefore, how to effectively achieve strong magnetic exchange through interface engineering has become one of the key issues in the construction of two-dimensional magnetic devices.

In this study, the researchers experimented with numerous materials and technical methods. They found that the two-dimensional iron germanium tellurium (Fe_3GeTe_2) material with ferromagnetic ground state can be induced into a homogeneous and magnetic heterostructure with

ferromagnetic-antiferromagnetic coexistence by uniaxial pressure technology.

At the same time, they discovered that the structure has a practical exchange bias effect.

This pressure-induced phase transition was confirmed by magneto-optical testing, high-resolution transmission electron microscopy, and first-principles calculations.

Since the ferromagnetic-antiferromagnetic coupling of the homogeneous and magnetic heterostructure of the material occurs inside the homogeneous junction, its exchange bias effect exhibited excellent characteristics thanks to the atomically smooth magnetic interface.

"These features (non-aging, extendable, and rechargeable) cannot be found in three-dimensional devices," said Hou De, a member of the team.

The results pave a new way for the design and development of high-performance two-dimensional magnetic devices, and their excellent exchange bias characteristics provide an opportunity for the effective application of two-dimensional magnetic devices.

More information: Caixing Liu et al, Emergent, Non-Aging, Extendable, and Rechargeable Exchange Bias in 2D Fe_3GeTe_2 Homostructures Induced by Moderate Pressuring, *Advanced Materials* (2022). DOI: 10.1002/adma.202203411

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