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Ferroelectric-ferromagnetic coupling in hexagonal $YMnO_3$ film.[1]
SHAOBO CHENG, MENGLEI LI, SHIQING DENG, SHANYONG BAO, PEIZHE TANG, WENHUI DUAN, JING MA, CEWEN NAN, JING ZHU, Tsinghua University — Simultaneously achieving ferroelectricity and ferromagnetism in a single phase material is an important research topic in recent decades. Here, we demonstrate that with the modulation of oxygen vacancies, the ferroelectric-ferromagnetic coupling can be realized in the typical hexagonal manganite: $YMnO_3$. The first-principal calculations are used to reveal the importance of oxygen vacancies on the alterations of magnetic behaviors for $YMnO_3$. In order to obtain net magnetic moments, the on-top oxygen vacancies of MnO_5 clusters should be created, thus the initial 2D spin frustration structure of Mn ions will be broken. By growing $YMnO_3$ film on Al_2O_3 substrate, large in-plane compressive strain is induced, thus we can experimentally realize the on-top oxygen vacancies. With the help of SQUID and spherical aberration corrected TEM, the magnetic moments are experimentally measured and the correlations between the crystal structures and magnetic properties can be clearly understood. Our findings may pave a way for future applications of single phase multiferroic materials.

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