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Stacking-dependent ferroicity of reversed bilayer: altermagnetism or ferroelectricity

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Abstract : Altermagnetism, as a new branch of magnetism independent of traditional ferromagnetism and antiferromagnetism, has attracted extensive attention recently. At present, researchers have proved several kinds of three-dimensional altermagnets, but research on two-dimensional (2D) altermagnets remains elusive. Here, we propose a method for designing altermagnetism in 2D lattices: bilayer reversed stacking. This method could enable altermagnetism-type spin splitting to occur intrinsically and the spin-splitting can be controlled by crystal chirality. We also demonstrate it through a real material of bilayer $PtBr_3$ with AB' stacking order. Additionally, the combination of stacking order and slidetronics offers new opportunities for electrical writing and magnetic reading of electronic devices. In the case of AC' stacking, interlayer sliding results in reversible spontaneous polarization. This unique combination of antiferromagnetism and sliding ferroelectricity leads to polarization-controlled spin-splitting, thus enabling magnetoelectric coupling, which can be detected by magneto-optical Kerr effect even without net magnetization. Our research highlights that reversed stacking provides a platform to explore rich physical properties of magnetism, ferroelectricity, and spin-splitting.

Keywords : Two-dimensional material, Altermagnetism, Magnetic and ferroelectric, Condensed matter physics and Materials Science
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