Two-dimensional Element Ferroelectricity with intrinsically stable charged domain walls

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Ferroelectric materials, particularly ferroelectricity in two-dimensional systems, have attracted significant interest over the past few years. However, nearly all reported ferroelectric materials are compounds composed of different types of atoms. Recently, despite being counterintuitive, we reveal spontaneous polarization and ferroelectricity in two-dimensional elemental group-V materials with a buckled lattice structure similar to black phosphorus, based on first-principles calculations and confirmed by experimental measurement. Additionally, we develop a general model to understand and search for potential two-dimensional ferroelectric and antiferroelectric materials. Using this model, we also discover that ferroelectric and antiferroelectric phases can exist in group-IV and group-VI elemental two-dimensional systems. More importantly, two-dimensional element ferroelectric materials exhibit anomalous negative piezoelectric coefficients and intrinsically stable charged domain walls, making them promising candidates for ultrathin ferroelectric devices with broad application prospects. The conclusions drawn from the study of elemental ferroelectric systems suggest the possibility of realizing unconventional ferroelectric effects in other ferroelectric systems, holding great potential for experimental realization and practical applications.

References

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