Imaging Electric Polarization Switching in Multilayer Graphene

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Fundamentally distinct from the conventional ferroelectrics, the most discriminative hallmark of the emerging two-dimensional (2D) sliding ferroelectricity is the polarization switching via the domain wall (DW) sliding. Meanwhile, multilayer graphene has recently attracted immense research attention owing to engineerable strong electron correlation and non-trivial band topology. Here, domain wall sliding-induced electric polarization switching is directly observed for the first time in multilayer graphene [1]. We identify adjacent polar domains of opposite electric polarizations in tetralayer graphene, the thinnest natural graphene polytype with broken inversion and mirror symmetries, by a gate-tunable nanoscale optical imaging technique. Remarkably, we directly observe and realize the DW sliding-induced polarization switching between these polar domains upon application of global and local electric fields, and mechanical forces. Our combined experiment and theory find a single DW sliding at the middlemost interface is responsible for the polarization switching. Our work opens new opportunities in studying sliding ferroelectricity in multilayer graphene, and demonstrates a novel optical readout method for sensitively and directly detecting electric polarization in 2D materials.

References

[1] Zhou Zhou, Xiyao Peng, Jianfeng Bi, Fei Xue, Jie Jiang, Huizhen Wu, Zhiwen Shi, Haoliang Qian, Toshikaze Kariyado, Sihan Zhao. Optical imaging of spontaneous electric polarizations in tetralayer graphene. arXiv:2504.06874 (2025)

Figures

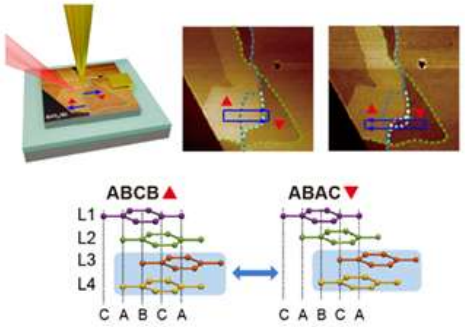

Figure 1: Domain wall sliding-induced electric polarization switching in tetralayer graphene