Ferroelectric domain writing in misfit layer compound $(PbS)_{1.18}VS_2$ using electron-beam lithography

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Sliding (moiré) ferroelectricity exists only in 2D materials where the out-of-plane polarization is switched by in-plane interlayer sliding and thus breaking the inversion symmetry [1]. So far, sliding ferroelectrics have been mostly observed in artificially created van der Waals multilayers, where manually exfoliated 2D layers are stacked on top of each other with a small twist angle θ between the individual layers [2 – 4].

Misfit layer compounds (MLC) are naturally grown materials that consists of alternating stacking of two different 2D materials forming an ordered superstructure. We focus on MLC $(PbS)_{1.18}VS_2$, formed by alternating layers of transition metal dichalcogenide VS_2 and transition metal monochalcogenide PbS. Bulk $(PbS)_{1.18}VS_2$ is stable at ambient conditions, shows semiconducting behaviour and exhibits sliding ferroelectric behaviour at room temperature. Ferroelectric domains with sizes varying between tens of nm up to tens of μm were observed using scanning electron microscopy (SEM) and scanning probe microscopy (SPM). We show that using electron-beam lithography, ferroelectric domains of arbitrary shape can be written. The written domains are thermodynamically stable and can be imaged using both SEM and SPM.

References

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