Physicists create polarization vortices in a two-dimensional material

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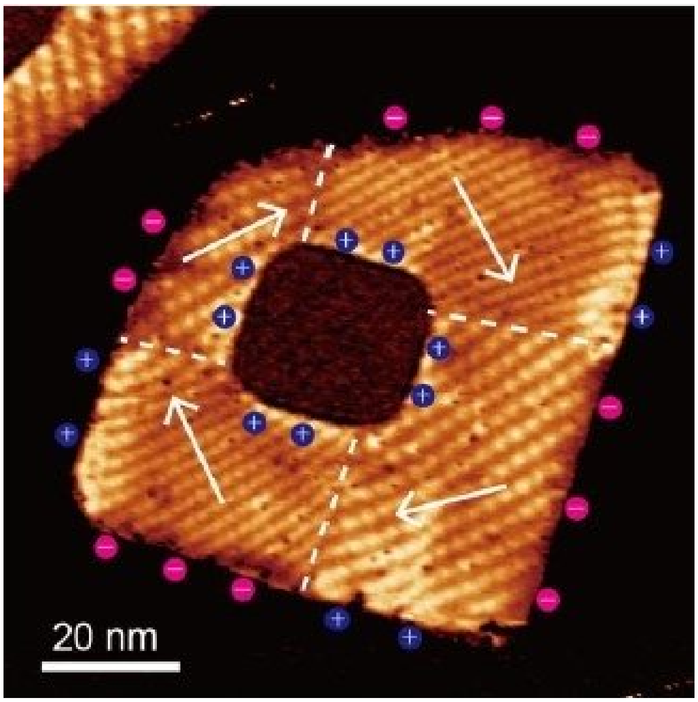

Scanning tunneling microscope topographic image of a SnTe/PbTe monolayer lateral heterostructure. The paraelectric PbTe monolayer core (dark) is surrounded by a ferroelectric SnTe monolayer, which develops a clockwise polarization vortex within its domains. Credit: Kai Chang/Max Planck Institute of Microstucture Physics

A University of Arkansas research team, in conjunction with researchers at the Max Planck Institute of Microstructure Physics and Beijing Academy of Quantum Information Sciences, has discovered polarization vortices in two-dimensional (2D) ferroelectrics.

University of Arkansas physics postdoctoral research associate John W. Villanova led the theory contribution to the paper which was recently published in *Advanced Materials*.

Experiments were performed at the Max Planck Institute of Microstucture Physics. SnTe/PbTe monolayer lateral heterostructures were produced via molecular beam epitaxial growth, and scanning tunneling microscopy measurements show an atomically sharp interface between the ferroelectric and paraelectric domains.

By carefully measuring the electronic band-bending at the edges of the SnTe monolayer, the polarization orientation was deduced to orient in a vortex consisting of four quadrants around the PbTe monolayer core, always with a component which points toward the core. The density functional theory calculations performed at the U of A contextualized the measurements in terms of relative work functions and charge transfer, consistent with the positive bound charge at the SnTe/PbTe monoayer interface.

This engineering of the polarization state in novel 2D lateral heterostructures with in-plane polarization has an eye toward applications.

More information: Kai Chang et al, Vortex-Oriented Ferroelectric Domains in SnTe/PbTe Monolayer Lateral Heterostructures, *Advanced Materials* (2021). DOI: 10.1002/adma.202102267

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