Ferroelectric Self-Poling in GeTe Crystals and Films

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Abstract. Ferroelectric materials are used in actuators or sensors due to their macroscopic ferroelectric polarization. GeTe is the simplest known diatomic ferroelectric endowed with exceedingly complex physics related to its crystalline, amorphous, thermoelectric and - fairly recently discovered topological properties, potentially interesting for spintronics applications. Typically, ferroelectric materials possess random oriented domains that need poling to achieve macroscopic polarization. By using X-ray absorption fine structure spectroscopy complemented with anomalous diffraction and piezo-response force microscopy, we investigated bulk ferroelectric structure from GeTe crystals and thin films. Both feature multi-domain structures in form of oblique domains for films and domain colonies inside crystals. Despite the multi-domain structures which are expected to randomize the polarization direction, our experimental results show that at room temperature there is a preferential ferroelectric order remarkably consistent with theoretical predictions from ideal GeTe crystals. This robust self-poled state has high piezoelectricity and additional poling revealed persistent memory effects.