

Imaging Domain Walls by Near Field Infrared Spectroscopy

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Ferroc materials are well known to exhibit heterogeneity in the form of domain walls. Understanding the properties of these boundaries is crucial for controlling functionality with external stimuli and for realizing their potential for ultra-low power memory and logic devices as well as novel computing architectures. In this work, we employ synchrotron-based near field infrared nano-spectroscopy to reveal the vibrational properties of ferroelastic (90 degree ferroelectric) domain walls in the hybrid improper ferroelectric $\text{Ca}_3\text{Ti}_2\text{O}_7$. By locally mapping the Ti-O stretching and Ti-O-Ti bending modes, we reveal how structural order parameters rotate across a wall. Thus, we link observed near-field amplitude changes to underlying structural modulations and test ferroelectric switching models against real space measurements of local structure. This initiative opens the door to broadband infrared nanoimaging of heterogeneity in ferroics.