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Direct Observation of Large Flexoelectric Bending at the Nanoscale in Lanthanide Scandates[1] PRATIK KOIRALA, CHRISTOPHER MIZZI, LAURENCE MARKS, Northwestern University — Large bending of materials can occur at the nanoscale in response to an electric polarization, what is called the flexoelectric effect, but to date this has not been observed directly. Most measurements reported in literature have relied upon the application of a small oscillatory strain gradient to induce. We report here the direct observation of large flexoelectric bending in [110] oriented $DyScO_3$ inside an electron microscope. Thin rods of $DyScO_3$ bent with under a converging electron beam. The bending was reversible with reduction in beam flux and could be cycled many times. Real time imaging of the bending was complemented with electron diffraction. Similar results were obtained for two other scandates of terbium and gadolinium. Characterization of the surface structure and electronic structure was done using X-ray photoelectron spectroscopy, ultraviolet photoelectron spectroscopy and reflection electron energy loss spectroscopy. Subsequently, we corroborated these observations with independent ex-situ measurements of the flexoelectric coefficient with a three-point bending setup. The relevant flexocoupling voltage was measured to be -42(2) V, which is higher than expected based upon current flexoelectric models.

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