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Strain-dependent, Extraordinary Magnetocrystalline Anisotropy in Sr_2CrReO_6 Epitaxial Films JEREMY LUCY, JENNIFER SOLIZ, MOLLY BALL, OSCAR RESTREPO, WOLFGANG WINDL, PATRICK WOODWARD, FENGYUAN YANG, The Ohio State University, ADAM HAUSER, University of California, Santa Barbara, JOHN FREELAND, Argonne National Laboratory, CENTER FOR EMERGENT MATERIALS COLLABORATION, MAGNETIC MATERIALS GROUP COLLABORATION — We have grown Sr_2CrReO_6 films that exhibit one of the largest anisotropy fields shown to date (18.1 T) and a large uniaxial magnetocrystalline anisotropy energy $K_u = 9.05 \times 10^6$ erg/cm^3. We investigate strain-controlled magnetocrystalline anisotropy for epitaxial Sr_2CrReO_6 films grown on $(LaAlO_3)_{0.3}(Sr_2AlTaO_6)_{0.7}$, $SrTiO_3$ and Sr_2CrNbO_6/LSAT substrates using high resolution X-ray diffraction, in-plane and out-of-plane superconducting quantum interference device magnetometry, and density functional theory calculations. The substrates impose tetragonal distortions of c/a = 1.025, 1.007 and 0.991, respectively, which lead to dramatic changes in magnetocrystalline anisotropy of order tens of tesla and a switching of the magnetic easy axis from in-plane for compressive strain to out-of-plane for tensile strain, as observed via magnetometry measurements. Density functional theory calculations elucidate the dependence of oxygen octahedra tilting and rotation on tetragonal distortions, which affect both electronic and magnetic properties of the films. Finally, X-ray magnetic circular dichroism measurements reveal strong magnetic moment contributions at the oxygen sites, as evident in oxygen-specific X-ray absorption spectra.

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