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Oxygen-vacancy-induced polar behavior in $(LaFeO_3)_2/(SrFeO_3)$ superlattices ROHAN MISHRA, SOKRATES PANTELIDES, Vanderbilt University, Oak Ridge National Laboratory, YOUNG-MIN KIM, Korea Basic Science Institute, Oak Ridge National Laboratory, JUAN SALAFRANCA, STEPHEN PENNYCOOK, ALBINA BORISEVICH, Oak Ridge National Laboratory, SEONG KEUN KIM, SEOHYOUNG CHANG, ANAND BHATTACHARYA, JEFFREY EASTMAN, DILLON FONG, Argonne National Laboratory — Complex oxides displaying ferroelectric and/or multiferroic behavior are of high fundamental and applied interest. In this work, for the first time, we show that it is possible to achieve polar order in a superlattice made up of two non-polar oxides by means of oxygen vacancy ordering. Using scanning transmission electron microscopy imaging, we show polar displacement of magnetic Fe ions in a superlattice of $(LaFeO_3)_2/(SrFeO_3)$ grown on a $SrTiO_3$ substrate. Using density functional theory calculations, we systematically study the effect of epitaxial strain. octahedral rotations and surface terminations in the superlattice and find them to have negligible effect on the antiferroelectric displacements of the Fe ions lying in between SrO and LaO layers of the superlattice. Introduction of oxygen vacancies, on the other hand, triggers a polar displacement of the Fe ions. We confirm this important result using electron energy loss spectroscopy, which shows oxygen vacancy ordering in the region where polar displacements are observed and an absence of vacancy ordering outside of that area. Overall our results open up a new pathway to design new ferroelectrics and multiferroics.

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