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Local Electrical Conductivity of Multiferroic Domain Walls QING HE, JAN SEIDEL, LANE MARTIN, YING-HAO CHU, QIAN ZHAN, FENG WANG, RAMAMOORTHY RAMESH, UC Berkeley — There is an intense interest in magnetoelectric coupling between electric and magnetic due to its potential to the revolutionary of device architectures. Single-phase multiferroics - materials that show spontaneous magnetization and polarization simultaneously at ambient conditions remain elusive as most systems (such as the manganites) exhibit multiferroicity only at low temperatures. Alternatively, multiferroics can be synthesized as a composite system, e.g. as a product property of a composite phase consisting of a magnetostrictive and a piezoelectric material. One multiferroic material, however, has played a key role in rejuvenating the field after a report of large ferroelectric polarization combined with interesting magnetic properties - $BiFeO_3$. Here we provide evidence of a unique property of single domain walls in multiferroic $BiFeO_3$. Unlike other multiferroic materials, e.g. $PbTiO_3$, on which the electronic properties of the domain walls are not significantly different from the domain area, we observe a finite electric conductivity at room temperature along such a wall using conductive atomic force microscopy. This intrinsic property of the domain wall is attributed to a changed crystallographic structure as revealed by high resolution transmission electron microscopy. Additionally, optical absorption measurements confirm a change in bandstructure at domain walls in $BiFeO_3$.

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