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Electron Holography Investigation of Resistive Switching CeO_2 / STO Nanocolumns

Frank Barrows[1], Xin Xu[2], Sossina Haile[3], Charudatta Phatak[1] and Amanda Petford-Long[1]

[1]Argonne National Laboratory, Chicago, Illinois, United States, [2]Stanford University, Stanford, California, United States, [3]Northwestern University, Evanston, Illinois, United States

To fully understand resistive switching in heterostructures it is necessary to observe in real space resistive switching along the heterostructure interface. Understanding the role of oxygen ion mobility on the variability of the resistance states is critical in order to enable control of resistive switching phenomena.[1] In heterostructures the interface offers a means to control resistive switching, but the role of the interface and the bulk needs to be understood. Sm doped CeO2/STO nanocolumns have demonstrated resistive switching and the resistive switching mechanism is proposed to occur along the interface of the CeO2 columns.[2] In this work we present an electron holography investigation of *in situ* nanobiasing experiments of Sm doped CeO2/STO nanocolumns and a quantitative investigation of the electric fields along the nanocolumn interface.

CeO2 nanocolumns in an STO matrix were grown by pulsed laser deposition. Thin films were obtained by focused ion beam milling, and Pt and Carbon top electrode and protective layers were deposited. *In situ* biasing was performed by making contact with a nanoprobe using the Hummingbird Nanobiasing holder. This experimental setup is shown in Figure 1 (a) and (b). Off-axis electron holography was performed during the *in situ* biasing. In (b) the columns of CeO2 are visible as dark stripes across the material.

Electron holograms were taken periodically during the biasing, which is shown in Figure 2. (a) shows an image obtained during electron holography. From the electron holograms an electron phase shift, reconstructed potential, and electric field are obtained, which are shown in Figure 2 (b), (c) and (d), respectively. Changes in the distribution in the electric field across the CeO2 and STO interface as a function of applied bias can indicate processes of filamentation and resistive switching. The map of the electric field in (d) highlights the nanocolumns.

We will present results on the *in situ* biasing experiments on CeO_2/STO nanocolumns. We will present potential profiles throughout a bias sweep. Additionally we will correlate local electric fields to the nanocolumn interface during *in situ* biasing.

References

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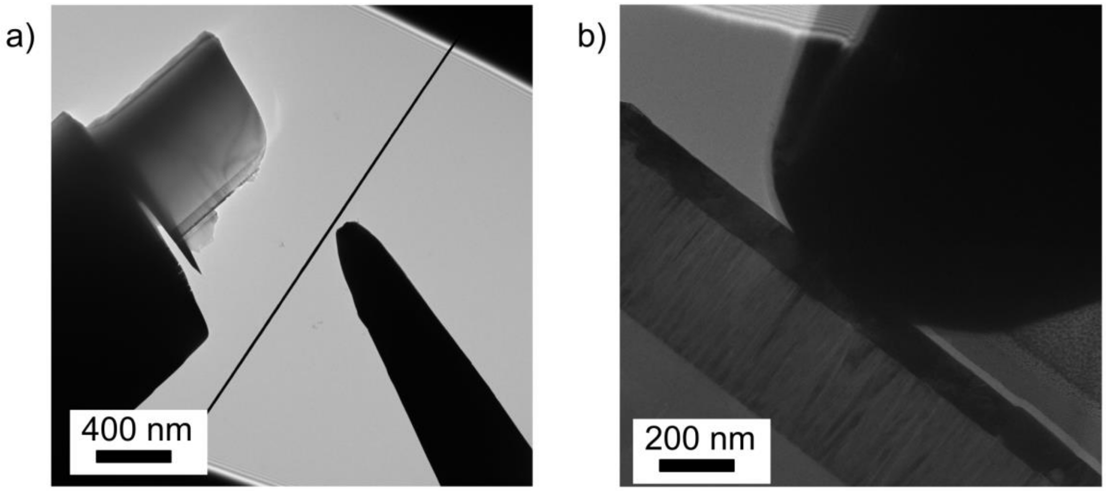

Figure 1. a) Bright field TEM image of Au probe and FIB sample of CeO2/STO nanocolumns. Pt biprism visible in the image. b) Bright field TEM image of nanoprobe contact on Pt top electrode. Electron holography interference visible at the top of the image.

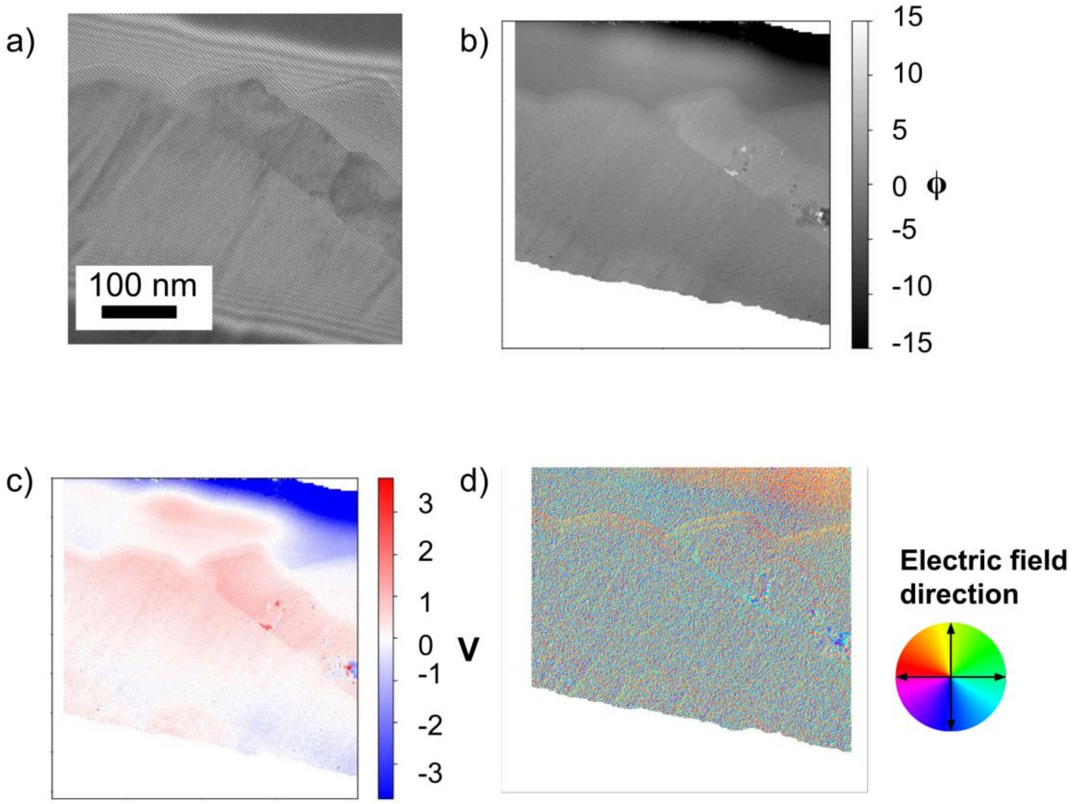

Figure 2. a) Electron holography image of CeO2/STO nanocolumns. The bright region is the interference region where phase information can be determined. b) Phase reconstruction of sample during in situ biasing experiment. c) Reconstructed potential when 5 Volts bias applied across sample. d) Local direction of electric field determined from reconstructed potential.