Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

***In Situ* Studies of Domain Dynamics and Wall Pinning Using Scanning Transmission Electron Microscopy**[1] HYE JUNG CHANG, SERGEI KALININ, Oak Ridge National Laboratory, PU YU, RAMAMOORTHY RAMESH, University of California Berkeley, SASWATA BHATTACHARYA, LONG-QUING CHEN, Pennsylvania State University, STEPHEN PENNYCOOK, ALBINA BORISEVICH, Oak Ridge National Laboratory — The mechanism of ferroelectric domain nucleation and growth is studied using in-situ Scanning Tunneling Microscopy (STM) – Scanning Transmission Electron Microscopy (STEM). A 300 nm multiferroic $BiFeO_3$ thin film is grown on $DyScO_3$ and has a large density of 71° domain walls. A local electrical field is applied using a W tip inside the STEM. Domain formation can be detected from the strain contrast associated with the newly formed ferroelastic domain wall. A step-wise increase of probe bias reveals the critical voltage for the formation of a new domain as 800 mV. This critical domain nucleation bias is much lower than the value observed by Piezoresponse Force Microscopy, which is of the order of 2-5 V. Notably, it also depends on the sample thickness along the beam direction. Repeated switching experiments in the vicinity of a pre-existing 71 ° domain wall reveal that the acute angle region between the domain wall and the surface is a preferential nucleation site. A strong asymmetry of domain wall pinning is observed during domain growth. The dependence of domain nucleation and growth kinetics on applied bias will also be discussed.

[1]The research is sponsored by the U.S. DOE Division of Materials Sciences and Engineering.

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Date submitted: 29 Nov 2009 Electronic form version 1.4