Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Investigation of the impact of hydrogen on the forming behavior of $Pr_{0.7}Ca_{0.3}MnO_3$ RF-sputtered thin films exhibiting Electric Pulse Induced Resistance change[1] MIHIR TENDULKAR, JOHN JAMESON, PETER GRIFFIN, YOSHIO NISHI, Stanford University - CIS — Flash scaling limits have generated interest in finding an alternative non-volatile memory. Resistance-change RAM (RRAM) is particularly attractive for its high density, high speed, and low power. Transition metal oxides that exhibit Electrical Pulse Induced Resistance (EPIR) change are ideal for RRAM. Thin films of NiO, $SrTiO_3$, TiO_2, $Pr_{0.7}Ca_{0.3}MnO_3$ (PCMO), and others have been studied extensively as promising memory candidates. However, these materials require an initial electrical forming step to induce soft breakdown into a conductive state before their EPIR properties can be accessed. Proposed models claim that forming propagates a filament of oxygen vacancies through the film, but little experimental attention has been devoted to tuning or eliminating this step. In this work, we study the forming step in RF-sputtered PCMO films. We show that forming changes dramatically with short, low-temperature anneals, and we link that result to hydrogen. We then investigate the effects of: 1) adding hydrogen directly into the sputtering plasma; 2) exposing PCMO thin films to water during patterning; and 3) alternating vacuum- and hydrogen-containing anneals. Our results indicate that hydrogen contamination plays a significant role in device variability and forming.

[1] The author gratefully acknowledges the Intel Foundation SRCEA Fellowship.

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Date submitted: 20 Nov 2009

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