Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Role of Oxygen in the Resistance Upturn of $LaAlO_3$ /$SrTiO_3$ Heterostructures[1] H. ZHANG, University of Toronto, J.H. NGAI, University of Texas at Arlington, C. AHN, Yale University, C. MCMAHON, D.G. HAWTHORN, University of Waterloo, J.Y.T. WEI, University of Toronto and the Canadian Institute for Advanced Research — Among the phenomena exhibited by $LaAlO_3/SrTiO_3$ (LAO/STO) heterostructures, the appearance of a low-temperature resistance upturn has attracted much recent debate [1-4]. This phenomenon has been observed to co-occur with both nonlinear Hall effect and negative magnetoresistance, and attributed to either the Kondo effect, multiband conduction, or weak localization. More importantly, it is primarily seen in samples grown by pulsed laser deposition, and is sensitive to film layer thickness, growth condition and electrostatic gating, all of which could affect the oxygen content. In this work, we study the occurrence of resistance upturn in samples grown by molecular beam epitaxy, and how the sheet resistance and Hall conductance are affected by post-growth oxygenation. X-ray photoelectron spectroscopy is used to monitor the cation valences, and correlate them with the conduction and magnetic properties. Our results are analyzed in terms of oxygen vacancies in the presence of polar charge transfer, and the effect of these vacancies on the resistance upturn in LAO/STO heterostructures.

[1] V. K. Guduru et al., PRB 88 (2013).
[2] Z. Huang et al., PRB 88 (2013).
[3] C. Bell et al., APL 94 (2009).
[4] A. D. Caviglia et al., Nature 456 (2008).

[1]Work supported by NSERC, CFI-OIT, the Canadian Institute for Advanced Research, and National Science Foundation Grant #1119826.

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Date submitted: 14 Nov 2014 Electronic form version 1.4