Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Microscopic origin of the oxygen reduction process and its impact on superconductivity in electron-doped copper oxides HYE JUNG KANG, University of Tennessee, NIST, University of Maryland, PENGCHENG DAI, University of Tennessee, ORNL, BRANTON J. CAMPBELL, Brigham Young University, PETER J. CHUPAS, STEPHAN ROSENKRANZ, PETER L. LEE, Argonne National Laboratory, QINGZHEN HUANG, NIST, SHILIANG LI, University of Tennessee, SEIKI KOMIYA, YOICHI ANDO, CRIEPI, Japan — The oxygen reduction process is one of the unique processes in the electron-doped high temperature copper oxides. Superconductivity is induced when the electron-doped as grown samples are annealed in the oxygen reduced atmosphere. Many experiments show that a small amount of oxygen reduction affects the mobility of charge carriers and it suppresses the long range antiferromagnetic order especially at high doping level. However, the detailed microscopic process of oxygen reduction and its effect on superconductivity are still unknown. Our x-ray and neutron scattering data, combined with chemical and thermo-gravimetric analysis measurements in the electron-doped $Pr_{0.88}LaCe_{0.12}CuO_4$ show that the microscopic process of oxygen reduction is to remove Cu deficiencies in the as-grown materials and to create oxygen vacancies in the stoichiometric CuO_2. Our results indicate that the role of annealing is to repair disorder in the CuO_2 plane induced by Cu deficiencies and to provide itinerant electrons for superconductivity.

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Date submitted: 16 Nov 2006 Electronic form version 1.4