Abstract No. igna745

The Effect of Photodoping on the Local Structure of YBCO

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Beamline(s): X18B, X23B

Introduction: It is well known that $YBa_2Cu_3O_{6+y}$ exhibit a significant enhancement of the normal state conductivity and an insulator to metal transition for *y*~0.4 due to the exposure to optical light (photodoping) [1]. Whether local structural changes are involved in these changes remains a question to be answered.

Methods and Materials: . We report on *c*-axis polarized Cu *K*-edge x-ray absorption measurements of $YBa_2Cu_3O_{6+y}$ films (*y*~0.3 and 0.94). All data were collected in FY, using PIPS detector at 300 K.

Results: XANES and EXAFS analysis of the optimally doped sample (*y*~0.94) do not show any appreciable change in its local structure at photon doses up to 10^{22} cm^{-2}. In contrast, XANES of the underdoped sample (*y*~0.3) reveals marked changes that are reminiscence of those found with oxygen doping. Cu *K*-edge multiple-scattering calculations of $YBa_2Cu_3O_{6.5}$ have been used to explain the experimental results. EXAFS analysis indicate that, on *average*, the Cu(1)-O(4) and Cu(2)-O(4) distributions tend to be broader in photodoped state. Fits to the experimental data suggest a double-peak Cu1-O1 distribution with a typical separation between the peaks of ~0.15 A. Though the *c*-axis measurements do not probe the electronic and local structure of the $Cu1\text{-}O1_{1+y}$ planes directly, our findings supports a microscopic model suggesting partial photoinduced diffusion of O1 atoms from a mostly disordered uniform arrangement to a *locally ordered* states where they group into short-range chains of $[O1\text{-}Cu1\text{-}O1]_n$ with *n*~ 1-3.

Acknowledgments: This research was supported by NSF-Career grant DMR-9733862.

References:

[1] V. I. Kudinov *et al*., *Phys. Rev. B* **47**, 9017 (1993).