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Hole doping in $YBa_2Cu_3O_{6+\delta}$ from polarization dependent x-ray absorption spectroscopy DAVID HAWTHORN, DARREN PEETS, KYLE SHEN, SUMAN HOSSAIN, GEORGE SAWATZKY, University of British Columbia, THOMAS KROLL, IFW-Dresden, JONATHAN DENLINGER, Lawrence Berkeley National Lab, RUIXING LIANG, DOUG BONN, WALTER HARDY, University of British Columbia — We present detailed polarization dependent x-ray absorption spectroscopy (XAS) measurements of the cuprate $YBa_2Cu_3O_{6+\delta}$ as a function of oxygen concentration for ($0 \leq \delta \leq 1$). By adding O into the chain layer of YBCO, holes are doped into both the CuO_2 planes and CuO_3 chains. The presence of O induced states is directly observed by measurements of the O K edge and Cu L edge XAS, which probes unoccupied states in the O $2p$ and Cu $3d$ orbitals respectively. Owing to the different symmetry of the Cu d orbitals in the planes ($d_{x^2-y^2}$) and chains ($d_{y^2-z^2}$), the contribution to the total XAS from the chains and planes is clearly separated by measuring the polarization dependence of the x-ray absorption. Comparison to LDA calculations of the unoccupied density of states are used to obtain a quantitative measure of the hole doping in the planes and chains as a function of O concentration. In addition, the doping of holes into the CuO_2 planes as a function of degree of oxygen order in the chains is observed by measuring $YBa_2Cu_3O_{6.5}$ in both the chain ordered (ortho II) and chain disordered phases. This provides direct evidence for the role of chain ordering on hole doping in YBCO.

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