Contribution ID: **1** Type: **Invited talk**

The symmetry and strength of the electron-phonon coupling in cuprates single crystals by Ultrafast Electron Crystallography.

Wednesday 6 April 2011 13:00 (40 minutes)

The phonon-mediated attractive interaction between carriers leads to the Cooper pair formation in conventional superconductors. Despite decades of research, the glue holding Cooper pairs in high-temperature superconducting cuprates is still controversial, and the same is true as for the relative involvement of structural and electronic degrees of freedom. Ultrafast electron crystallography (UEC) offers, through observation of spatio-temporally resolved diffraction, the means for determining structural dynamics and the possible role of electron-lattice interaction. A polarized femtosecond (fs) laser pulse excites the charge carriers, which relax through electron-electron and electron-phonon coupling, and the consequential structural distortion is followed diffracting fs electron pulses. In this talk, the recent findings obtained on single crystal samples are summarized. In particular, we show the strength and symmetry of the directional electron-phonon coupling in BSCCO; the theoretical implications of these results are discussed with focus on the possibility of charge stripes being significant in accounting for the observed polarization anisotropy. We show that while the average electron-phonon coupling at optimal doping is rather weak, consistent with literature reports, selected atomic motions can be coupled much stronger to polarized excitations. The coupling to the out-of plane motions of oxygen ions is also found to gain strength and exhibit a dramatic temperature dependence at lower doping. The characteristic time for electron-phonon scattering is obtained for these particular modes, and is found to be comparable to the time-scale associated to the magnetic exchange energy J.

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Session Classification: High-Tc superconductors