MAR06-2005-001830

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

Evolution of superconductivity in electron-doped cuprates[1]

GIRSH BLUMBERG, Bell Labs, Lucent Technologies

The superconducting (SC) phase diagram of the electron-doped cuprates has been explored by Raman spectroscopy as a function of polarization, temperature and magnetic field. The SC gap magnitudes in optimally- and over-doped samples are in agreement with the single particle spectroscopy measurements. An in-gap collective mode has been observed in the B_{2g} channel for the under-doped samples. The SC coupling strength decreases with increasing Ce concentrations from the strong- coupling regime for the under-doped sample to a weak-coupling at optimal doping and beyond. The persistence of SC coherence peaks in the B_{2g} channel for all dopings implies that superconductivity is mainly governed by interactions in the vicinity of $(\pm\pi/2a,\ \pm\pi/2a)$ regions of the Brillouin zone (BZ). Well- defined SC coherence peaks in the B_{1g} channel occur for optimally-doped samples and this implies that the electron-like carriers near the $(\pm\pi/a,\ \pm\pi/4a)$ and $(\pm\pi/4a,\ \pm\pi/a)$ regions of the BZ are also gapped at this doping. Low energy scattering below the SC coherence peak energies for all dopings and Raman symmetries is due to nodal QPs. However, the order parameter is more complicated than a simple monotonic $d_{x^2-y^2}$. We have studied the field and temperature dependence of the SC gap magnitude and the integrated intensity of the 2Δ coherence peaks and extract an effective upper critical field line $H_{c2}^{*}(T,x)$ at which the superfluid stiffness vanishes. The field dependence of the measured SC gap reveals an estimate of $H_{c2}^{2\Delta}(T,x)$, an upper critical field at which the SC amplitude is suppressed by field. For optimally-doped samples, the field effectively suppresses the superfluid stiffness while the SC amplitude survives higher fields suggesting a phase fluctuation regime for these samples.

[1]Work done in collaboration with M. M. Qazilbash, A. Koitzsch, B. S. Dennis, C. A. Kendziora, and R. L. Greene