MASTER'S THESIS

Conductivity fluctuations in yttrium barium cooper oxides

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CONDUCTIVITY FLUCTUATIONS IN YTTRIUM BARIUM COPPER OXIDES

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ABSTRACT

This work concerns conductivities in high-T_c superconductors at temperatures above T_c, at which the transition from the normal to the superconducting state occurs. The materials studied are polycrystalline yttrium barium copper oxides containing different oxygen deficiencies (δ) and various concentrations (X) of zinc in substitution for copper. The conductivity, σ, consists of two components: the normal-state σ, and the paraconductivity due to local thermodynamic fluctuations into the superconducting state. By extrapolating from the linear region I separate each set of measured $\sigma(T)$ data into the two components. It is found that the residue resistivity belonging to the normal state rises with both δ and X. T_c first increases then decreases with increasing δ, but it drops continuously with increasing X. On the other hand, oxygen deficiency enhances conductivity fluctuations, provided that zinc doping is absent or low, but zinc substitution depresses the fluctuations, at small δ. The paraconductivity component has been analysed with the Aslamazov-Larkin and the Lawrence-Doniach models, with the latter offering the best fit. From such analyses the Ginsburg-Landau coherence lengths and the superconducting layers separations can be estimated. The Ginsburg temperatures have also been obtained, and their trends with δ and X are consistent with that of coherence lengths. These deductions provide evidence that the supercurrent is confined to the Cu-O_2 planes, but the Cu-O chains take part in the formation of superconducting pairs.

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