E1-22: AC magnetic susceptibility and resistivity of a superconducting $YBa_2Cu_3O_{7-\delta}$ single crystal in the presence of a magnetic field

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In addition to determination of the superconducting transition temperature (T_c), AC susceptibility measurements have sometimes been used to determine the apparent DC irreversibility line associated with the peak position of the imaginary part X''(w ,H,T). However the physical meaning of the peak in X''(w ,H,T) curves is at present controversial since the strictly irreversible behaviour at the frequency limit w -> O is clearly not accessible by this measurement technique.

In this work, AC susceptibility X(H,T) and resistivity p(H,T) measurements were carried out for a $YBa_2Cu_3O_{7-\delta}$ single, in a mixed state ($H_{C1} > H > H_{C2}$) by applying a magnetic field H parallel to the C-axis. These results were compared with results from DC magnetization measurements for the same single crystal. Results strongly suggest that the occurrence of the dissipation peak in the imaginary part of the complex AC susceptibility X'' is due to the skin effect known for electrical transport in metals in the normal state. The peak temperature increased with increasing frequency and did not coincide with the irreversibility temperature obtained in the static limit.

A magnetic phase diagram including the DC irreversibility line, the peak positions from the AC susceptibility data, and the experimentally resolved zero resistivity temperature in magnetic fields is also presented. All these measurements were taken for the same $YBa_2Cu_3O_{7-\delta}$ single crystal which eliminates sample quality on interpretations.