Comment on "Observation of the Conductivity Coherence Peak in Superconducting $Bi_2Sr_2CaCu_2O_8$ Single Crystals"

In a recent publication [1], a peak in the real part of the conductivity $\sigma_1(T) = \mathrm{Re}[\sigma_1(T) - j\sigma_2(T)]$ versus temperature was observed from measurements of the surface impedance of $Bi_2Sr_2CaCu_2O_8$ single crystals and identified with the so-called coherence peak. The observed peak was considerably narrower and occurred much closer to T_c than expected for an ordinary coherence peak. The authors conclude that such a behavior is due to strong coupling effects. The existence of a coherence peak is inconsistent with NMR measurements on $YBa_2Cu_3O_7$ powders [2] which do not display such a peak. We have also observed peaks in the rf conductivity from impedance measurements of $YBa_2Cu_3O_7$ thin films [3] but are able to explain the data of Holczer *et al.* and our data from a broadened superconducting transition, using a two-fluid model that simulates a temperature dependence without coherence effects.

Figure 1 shows a set of measured peaks in $\sigma_1(T)$ at frequencies 20, 50, 100, 200, and 450 MHz for our thin-film stripe [4], and Fig. 2 a set of simulations using a broadened transition for 50, 500, and 5000 MHz, respectively. Both simulations and the film have a broadened transition from about 89 to 90.5 K. Experimentally, we observe conductivity peaks positioned very close to the zero-resistance temperature and with a width comparable to the broadened T_c. Holczer *et al.* who have a broader resistive transition at their measurement frequency also measure a correspondingly broader peak in $\sigma_1(T)$. Our peaks broaden, reduce in height, and move slightly to higher temperatures as the frequency is increased. The simulations using a distribution of T_c's reproduce these features in width, height, position, and frequency dependence. Since the conductivity experiments actually measures the complex impedance, the real part of the admittance must be calculated from the measured data. Broadening of the transition mixes the large increase in $\sigma_2(T)$ in one part of the sample with one T_c with the sharp drop in $\sigma_1(T)$ in another part of the sample with another T_c, thus producing the peak.

We have shown that the observed conductivity peak results naturally from an impedance measurement and this result is not inconsistent with NMR data. The observation of such a peak in itself does not demonstrate the existence of coherence effects.

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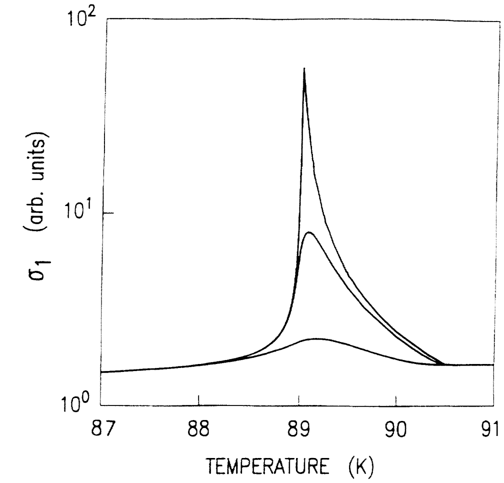

FIG. 2. Calculations of the conductivity peak using a broadened superconducting transition for frequencies 50, 500, and 5000 MHz, as displayed from the top. The T_c is continuously smeared from 89 to 90.5 K.

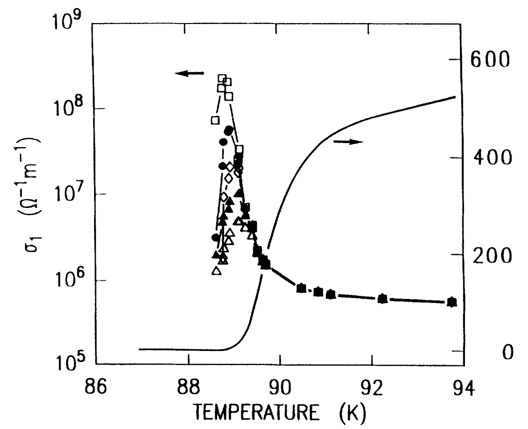

FIG. 1. Experimentally observed conductivity peaks at frequencies 20, 50, 100, 200, and 450 MHz as displayed from the top of the figure (markers). The dc resistance is also shown (solid line).

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