Kamarás *et al.* Reply: The Comment by Orenstein and Rapkine makes the point that the infrared reflectance of high-T_c superconductors is affected by crystal anisotropy in a sample of large randomly oriented grains. They suggest that the reflectance can be modeled with use of a simple Drude dielectric function for the *a-b* plane,

$$\epsilon(\omega)=\epsilon_\infty-\omega_p^2/(\omega^2+i\omega/\tau),$$

with plasma frequency $\omega_p=2.5$ eV (20000 cm^{-1}) and inverse lifetime $1/\tau=0.6$ eV (5000 cm^{-1}) ($\tau=1\times10^{-15}$ sec). This Drude dielectric function is characterized by a mode at zero frequency, broadened to $\sim 1/\tau$ by scattering processes.

Although the point about anisotropy is valid (as seen already by fits to optical data obtained either by averaging reflectances[1] or from an effective-medium treatment[2]), we disagree strongly with the use of a Drude dielectric function to describe the infrared spectrum. Considerable evidence points to a strong *non-Drude* absorption in the mid infrared in the high-T_c superconductors.

In the Drude model, the same relaxation time governs the dc conductivity, $\sigma_1(0)=\omega_p^2\tau/4\pi$, and the high-frequency absorption. This model is inconsistent with the known temperature dependence of the dc and mid-infrared properties. The dc resistivity of many samples follows[3,4] $\rho=\rho(0)+aT$. This temperature dependence is seen[4] between T_c and 1000 K in LaSrCuO and up to 600 K in YBaCuO. In the best samples $\sigma(0)\simeq 0$. In contrast, the mid-infrared conductivity is essentially temperature independent.[5] If we invoke the sum rule that the area under $\sigma_1(\omega)$ is a constant, this difference between dc and optical temperature dependences would permit a Drude-type behavior at only *one* temperature.

Both the 2.5-eV plasma frequency and the 0.6-eV relaxation rate obtained by fits to the Drude model are unreasonably large. Muon-spin resonance[6] and Hall[7] measurements point to a 1.0–1.4-eV plasma frequency for the carriers contributing to the dc conductivity. Our recent far-infrared study[8] of a textured $YBa_2Cu_3O_7$ sample found a free-carrier contribution characterized (at 100 K) by $\omega_p=0.8$ eV and $1/\tau=0.03$ eV. The large $1/\tau=0.6$ eV used by Orenstein and Rapkine and others[1,2,9,10] gives an unphysical mean free path, $l=v_F\tau=2$ Å, using $v_F=2\times10^7$ cm/sec.

The carrier concentration, n, determines the plasma frequency, $\omega_p=(4\pi ne^2/m^*)^{1/2}$. Within the Drude model, the plasma minimum should shift with changes in carrier concentration. In LaSrCuO the carrier concentration is generally assumed to equal the Sr concentration x for $x<0.18$, making the plasma frequency dependent on x within a Drude model. No such shift is observed.[11,12]

From this it follows that the mid-infrared band is caused by an absorption process and not by the elastic scattering of free carriers, i.e., not by a Drude absorption. Although the exact mechanism involved is not clear, we have suggested[5,13] a charge-transfer excitation (or exciton) as the source of this absorption. Another mechanism might be an extremely strong multiphonon emission band, either associated with free carriers (a Holstein[14] absorption) or with self-trapped holes (a Brandt-Brown[15] absorption). The contribution of these inelastic processes goes to zero at zero frequency, thus not affecting the dc conductivity.

We do agree that the optical effects described by Orenstein and Rapkine can alter the shape of the absorption band and cause it to shift to higher frequency in randomly oriented ceramic superconductors. We do not agree that the original unshifted *a-b*-plane band is zero-frequency-centered Drude absorption.

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