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Title:

Pump Probe Excitation Spectroscopy of Noble Metals and Insulating Cuprates

Abstract:

We study the transient optical response of optically thick films of the noble metals Au and Cu and optically thick single crystals of La$_2$CuO$_4$, YBa$_2$Cu$_3$O$_6$ and Sr$_2$CuO$_2$Cl$_2$ as a function of pump of excitation wavelength, probe wavelength and pump fluence. At the same pump fluence, the noble metals show a significant variation in the amplitude of their transient reflectivity with pump photon energy, which occurs due to two main sources: the photon energy dependence of the permittivity and the spatial variation in transient electron temperature. Three cascaded models are sufficient to obtain agreement between experimental measurements and simulation results, which allows estimation of the electron-phonon coupling constant, g. For Au, we estimate $g = 2.3 \pm 0.1 \times 10^{16}$ W/m^{3}K and for Cu, $g = 1.1 \pm 0.1 \times 10^{17}$ W/m^{3}K, consistent with literature results but with improved precision.

In the insulating cuprates, all three materials show similar behaviour, with a change in sign of the transient reflectivity spectrum near the effective energy gap. In non-equilibrium conditions, the location in energy of this crossing changes by up to 0.4 eV, demonstrating that charge transfer energy gap is strongly affected by photoexcitation. We also observe that the transient reflectivity saturates at around 500 μJ/cm^2 for 2.8 eV pump photons.