Time-resolved far-IR Spectroscopy of Quasiparticle Recombination in Nb(Ti)N Films

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Nb(Ti)N is a BCS-type metallic superconductor with a moderately high transition temperature (over 10K). The lifetime for excess quasiparticles in this material has not been studied previously by time-resolved methods. We have used pump-probe spectroscopy to measure the excess quasiparticle density under conditions of constant laser fluence (**Figure 1**) and effective lifetime as a function of temperature (**Figure 2**). We find that the excess quasiparticle density increases with decreasing temperature in a manner consistent with a BCS-based calculation. The detailed temperature dependence is controlled by the ratio of the intrinsic recombination lifetime τ_R and the lifetime for excess 2Δ phonons to break pairs τ_B. Our results suggest that τ_R/τ_B is approximately 5 at a temperature of $T_c/2$ (solid curve in **Figure 1**). The effective lifetime is approximately 500 ps near T_c, increasing strongly as the temperature falls below $T_c/2$. While this is more-or-less the expected behavior, agreement with theory (solid curve) is less than ideal.

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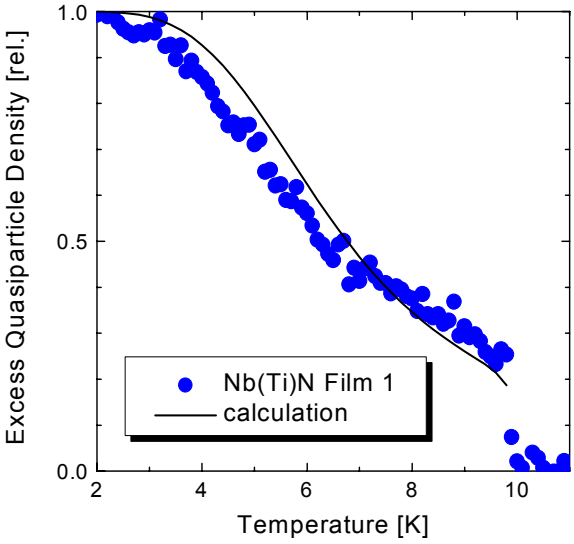

Figure 1. Excess quasiparticle density as a function of temperature for constant fluence.

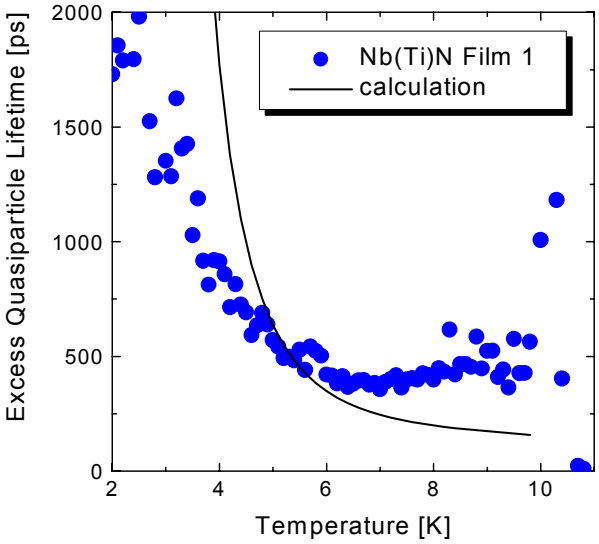

Figure 2. Effective lifetime for excess quasiparticles in a Nb(Ti)N film on sapphire.