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Temperature Dependent Excess Quasiparticle Relaxation in Nb, Nb(Ti)N and $BaPb_xBi_{1-x}O_3$

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Far-infrared, pump-probe spectroscopy has been used to measure the relaxation of excess quasiparticles in Nb, Nb(Ti)N and $BaPb_xBi_{1-x}O_3$ thin film superconductors. We have measured both the effective recombination time (tau_{eff}) and the relative excess quasiparticle density (n_{qp}/n_0) from $0.25T_c$ up to T_c. The temperature-dependent results were analyzed using a linearized form of the Rothwarf-Taylor equations that takes into account the phonon bottleneck for quasiparticle recombination. The behavior of tau_{eff} and n_{qp}/n_0 is sensitive to the ratio tau_R/tau_B, where tau_R is the intrinsic recombination time and tau_B is the phonon pair-breaking time. The detailed shape for $tau_{eff}(T)$ in both Nb and Nb(Ti)N suggests a T-dependent bottleneck. In contrast, tau_{eff} for $BaPb_xBi_{1-x}O_3$ shows almost no T-dependence. Such behavior may be due to inhomogeneity where recombination can occur at interfaces.