Temperature Dependent Excess Quasiparticle Relaxation in Nb, Nb(Ti)N and BaPb$_x$Bi$_{1-x}$O$_3$


$^1$Brookhaven National Laboratory
$^2$CNRS-Orsay
$^3$University of Florida
$^4$CEA-Saclay
$^5$Seoul University
$^6$Jet Propulsion Lab

Far-infrared, pump-probe spectroscopy has been used to measure the relaxation of excess quasiparticles in Nb, Nb(Ti)N and BaPb$_x$Bi$_{1-x}$O$_3$ thin film superconductors. We have measured both the effective recombination time ($\tau_{\text{eff}}$) and the relative excess quasiparticle density ($n_{\text{qp}}/n_0$) from 0.25$T_c$ 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 $\tau_{\text{eff}}$ and $n_{\text{qp}}/n_0$ 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 $\tau_{\text{eff}}(T)$ in both Nb and Nb(Ti)N suggests a $T$-dependent bottleneck. In contrast, $\tau_{\text{eff}}$ for BaPb$_x$Bi$_{1-x}$O$_3$ shows almost no $T$-dependence. Such behavior may be due to inhomogeneity where recombination can occur at interfaces.