The Electrodynamics Properties of Superconducting $Nd_{0.8}Sr_{0.2}NiO_2$ Nickelate

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The intensive search for alternative non-cuprate high-transition-temperature (T_c) superconductors has taken a positive turn recently with the discovery of superconductivity in infinite-layer nickelates. This discovery is expected to be the basis for disentangling the puzzle behind the physics of high T_c in oxides. In the unsolved quest for the physical conditions necessary for inducing superconductivity, we report on a broad-band optical study of a $Nd_{0.8}Sr_{0.2}NiO_2$ film measured using optical and Terahertz spectroscopy, at temperatures above and below the critical temperature $T_c \sim 13$ K. The normal-state electrodynamics of $Nd_{0.8}Sr_{0.2}NiO_2$, can be described by a scattering time at room-T (τ=1.3 × 10^{-14} s) and a plasma frequency (ω_p =5500 cm^{-1}) in combination with an absorption band in the Mid-Infrared (MIR), characteristics of transition metal oxides, located around $\omega_0 \sim 2500$ cm^{-1} and with an amplitude ω_{MIR} of about 8000 cm^{-1}. The degree of electronic correlation can be estimated using the ratio $\omega^2_p /(\omega^2_p + \omega^2_{MIR})$. In the present system, this value is about 0.32 indicating a strong electron correlation in the NiO_2 plane with a similar strength as cuprates. From 300 K to 20 K, we observe a spectral weight transfer between the Drude and MIR band, together with a strong increase in the Drude scattering time, in agreement with DC resistivity measurements. Below T_c, a superconducting energy gap $2\Delta \sim 3.3$ meV can be extracted from the Terahertz reflectivity using the Mattis-Bardeen model.