

# Optical plasmonic response of niobium around the superconducting transition temperature

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We present the first experimental evidence of a direct link between the optical properties of a material and onset of superconductivity.

By measuring the dielectric constants of an unpatterned niobium film as well as the reflectivity of a nanostructured niobium metamaterial, we demonstrate a critical dependence of niobium optical response on temperature near its superconducting transition at 9K. Our studies point to a hitherto unknown connection between superconductivity and optical range plasmonics. We explain the experimentally observed critical dependence of the metamaterial resonance position on the transition temperature of niobium by means of a thermodynamics-based model that takes into account the change in the free energy of the metamaterial resonator between the normal and superconducting states. We argue that this is a signature of the transition to the superconducting state, which is detected by infrared photons.