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Wide-band spectroscopic study of in-gap excitations in epitaxial $DyBa_2Cu_3O_7$ superconducting films R. D. DAWSON, Max Planck Institute for Solid State Research, D-70569 Stuttgart, Germany, B. REBER, Max Planck–UBC Centre for Quantum Materials, G. CHRISTIANI, G. LOGVENOV, B. KEIMER, A. V. BORIS, Max Planck Institute for Solid State Research, D-70569 Stuttgart, Germany — Investigations of the electronic ground state properties of copper oxide high-temperature superconductors have revealed a complex array of competing forms of order across the phase diagram, suggesting the existence of dipole-active excitations at low energies and across a wide range of doping levels. [1] These excitations are expected to manifest even at frequencies below 2Δ; however, due to strong optical response of the superconducting condensate below T_c, signatures of in-gap excitations can be masked and their direct measurement is challenging. Here, we have applied three complementary phase-sensitive techniques of submillimeter interferometry using backward wave oscillator sources, high-resolution time domain terahertz spectroscopy utilizing the asynchronous optical sampling technique at 1GHz repetition rate, and synchrotron-based far-infrared ellipsometry to sensitively probe the in-gap states of $DyBa_2Cu_3O_7$ epitaxial films grown by atomic-layer-by-layer oxide MBE. By combining the measured data we have obtained the continuous complex dielectric function in the spectral range of 0.5meV to 0.5eV and have observed its evolution as a function of temperature between 7K and 300K.

[1]B. Keimer, et al. Nature 518 (2015) 179.

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