Non-equilibrium superconductivity in a two-band superconductor MgB_2 driven by narrow-band THz pulses

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Light-enhancement of superconductivity in conventional BCS superconductors was first been demonstrated over 50 years ago, where the fascinating observation of enhancement of critical temperature, critical current and the superconducting gap under illumination with electromagnetic radiation at sub-gap frequencies was accounted for by Eliashberg by considering the self-consistent gap equation under radiation induced non-thermal quasiparticle distribution [1]. With these effects relying on non-thermal QP distribution, such observations were limited to materials with large electron mean free paths [2]. Yet, even in NbN signatures of gap enhancement were observed on the 50 ps timescale when exciting with narrow band THz pulses [3].

Given the low normal-state scattering rate and rather large superconducting gap in the σ-band, such gap enhancement effects may be expected also in a two-gap superconductor MgB_2 [4], when excited with narrow-band THz pulses. Here, we report on studies of the superconducting state dynamics in MgB_2 thin films utilizing both, narrowband THz pulses tuned between energies of the superconducting gaps in the π- and σ-bands, and near-infrared excitation. The results on temperature and excitation density dependence of the gap suppression under THz pumping reveal pronounced superconductivity enhancement effects at temperatures close to T_c, which are consistent with the Eliashberg scenario.

References

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