Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Nonlinear Response of the High-Temperature Superconductor $YBa_2Cu_3O_{7-\delta}$ to the Transmission of Intense Terahertz Pulses[1] IWAO KAWAYAMA, Osaka Univ. and PRESTO-JST, ANDREAS GLOSSNER, Osaka Univ. and Universität Erlangen-Nürnberg, CAIHONG ZHANG, SHINYA KIKUTA, HIRONARU MURAKAMI, Osaka Univ., PAUL MÜLLER, Universität Erlangen-Nürnberg, MASAYOSHI TONOUCHI, Osaka Univ. — High-Power Terahertz Time-Domain Spectroscopy (THz-TDS) was used to examine $YBa_2Cu_3O_{7-\delta}$ thin films when transmitted by intense single-cycle THz pulses. This allowed for an investigation of the nonlinear, time-resolved behavior of $YBa_2Cu_3O_{7-\delta}$ in the presence of strong THz electric fields for the first time. High field strengths of tens of kV cm^{-1} were achieved by improving the efficiency of optical rectification in $LiNbO_3$ through the tilted-pulse-front method and by ensuring a tight focusing of the THz beam. In the case of low field strengths, the behavior of the thin films agrees with previous examinations of $YBa_2Cu_3O_{7-\delta}$ by means of conventional, low-power THz-TDS. However, for strong THz electric fields, it was found by analysis with the two-fluid model that the superfluid population decreases dramatically, possibly due to Cooper pair breakup. This was accompanied by a drop in the imaginary part of the conductivity in the investigated frequency range of 0.2 to 0.8 THz. The results further suggest a decrease of the effective mass of the carriers for strong THz fields.

[1]This work is partially supported by Grant-in-Aid A22246043, JSPS, and Industry-Academia Collaborative R&D, JST.

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Date submitted: 16 Nov 2011 Electronic form version 1.4