Photoresistance of a Two-Dimensional Electron Gas at Sub-Terahertz Frequencies

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Introduction

With a few exceptions, studies of microwave photoresistance in high-mobility two-dimensional electron systems have been limited to microwave frequencies below 100 GHz [1]. Here we report on photoresistance measurements using sub-terahertz frequencies, extending studies to higher magnetic fields.

Experimental

Magnetotransport measurements were performed in SCM-2 under continuous irradiation by sub-terahertz (0.2 to 0.4 THz) radiation generated by a backward wave oscillator. Hall bar samples were fabricated from GaAs/AlGaAs quantum wells with densities of ~3×10^{11} cm^{-2} and mobilities of ~2×10^{7} cm^2/Vs.

Results and Discussion

As shown in Fig. 1(a), in addition to microwave-induced resistance oscillations, we have observed a series of narrow peaks [marked by ↓], occurring near the cyclotron resonance (cf. vertical line marked by 1). Some of these peaks are extremely high and their relative strength depends on the sweeping direction of the magnetic field. At lower radiation intensity and lower temperatures, these giant photoresistance peaks are no longer observed [see Fig. 1(b)] and the magnetoresistance is dominated by Shubnikov-de Haas oscillations (SdHO). Here, the data reveal strong suppression of the SdHO near the cyclotron resonance, and to a lesser extent, near its harmonics. Another interesting feature of the data is a series of sharp radiation-induced extrema, which are more pronounced near the SdHO maxima and are roughly equally spaced in magnetic field [see Fig. 1(c)].

Conclusions

Photoresistance at sub-terahertz frequencies reveals several unexpected phenomena. Understanding the origin of these effects remains a subject of future studies.

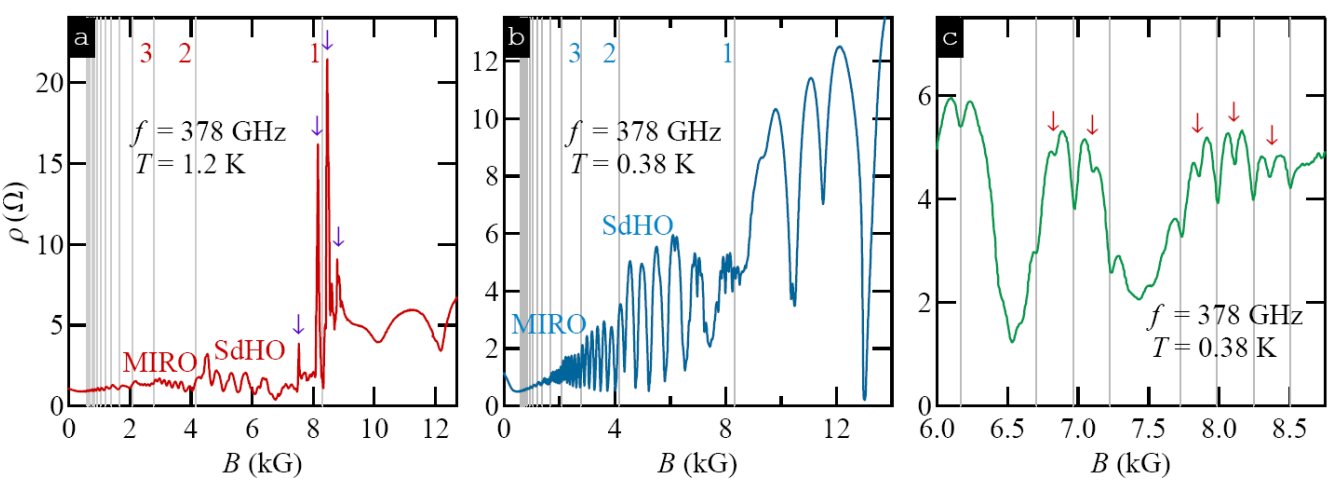

Fig. 1. Magnetoresistivity ρ(B) under microwave irradiation of frequency f = 378 GHz at (a) higher intensity and T = 1.2 K and (b,c) lower intensity and T = 0.38 K.

Acknowledgements

This work was supported by the DOE DE-SC002567 (Minnesota) and DE-SC0006671 (Purdue). The work at Princeton was partially funded by the Gordon and Betty Moore Foundation and the NSF MRSEC Program through the Princeton Center for Complex Materials (DMR-0819860). Work at the NHMFL was performed under NSF Cooperative Agreement No. DMR-1157490, the State of Florida, and the U.S. Department of Energy.

References

[1] Dmitriev I. A., Mirlin, A. D., Polyakov, D. G, and Zudov, M.A., Rev. Mod. Phys, **84**, 1709 (2012)