Nonequilibrium Magnetotransport in a 2D Hole Gas Hosted in a Ge/Sige Quantum Well

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Introduction

Microwave-induced oscillations (MIRO) and Hall field-induced oscillations (HIRO) have been discovered long ago [1] but, until recently, remained unique to GaAs/AlGaAs systems [2]. Here, we report on the observation of MIRO and HIRO [3] in a two-dimensional hole gas (2DHG) hosted in a high-mobility Ge/SiGe quantum well.

Experimental

Measurements were performed in SCM-2 on a 50 μm-wide Hall bar containing 2DHG in a Ge/SiGe quantum well with the density 2.8×10^{11} cm^{-2} and the mobility 1.3×10^{6} cm^2/Vs. Photoresistivity $\delta\rho_\omega(B)$ was measured under 0.2 - 0.4 THz radiation generated by a backward wave oscillator and the differential resistivity $r(B)$ was measured at currents I up to 50 μA.

Results and Discussion

In Fig. 1(a) we present photoresistance under microwave irradiation of frequency f = 202 GHz which reveals four MIRO maxima and minima. The analysis of these data yields the effective hole mass $m^* \approx 0.09\, m_0$ and the quantum lifetime $\tau_q \approx 2.8$ ps. In Fig.1(b), we show the differential resistivity at different current densities obtained without microwave irradiation. The data reveal a pronounced maximum at a magnetic field which increases linearly with the applied current. We associate this maximum with the fundamental HIRO peak. After taking into account the Dingle factor correction, we find that the position of the HIRO peak is well described by the same hole effective mass $m^* \approx 0.09 m_0$, obtained from the data in Fig. 1(a).

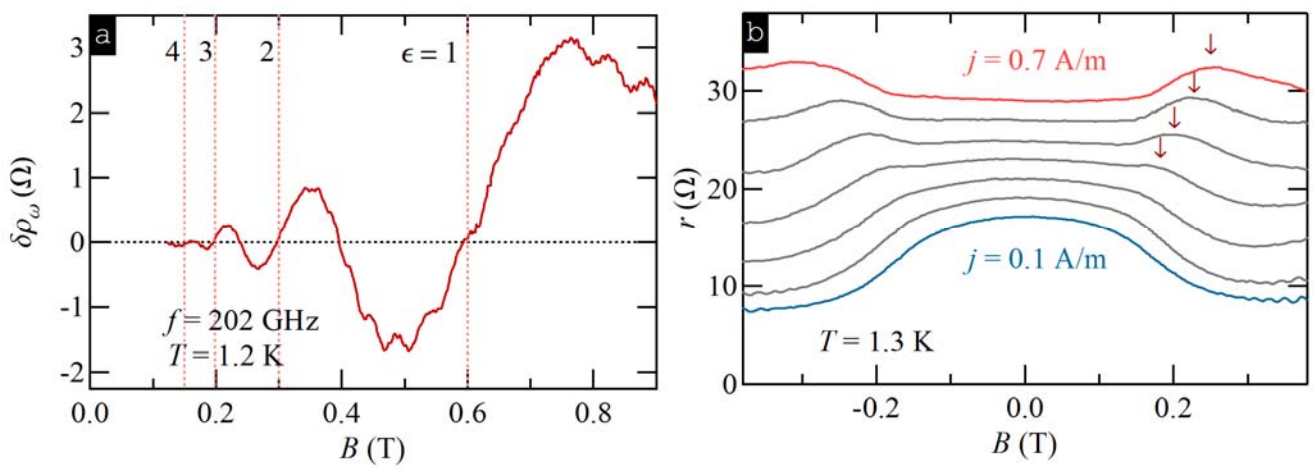

Fig. 1. (a) Photoresistivity $\delta\rho_\omega(B)$ under radiation of f = 202 GHz. (b) Differential resistivity $r(B)$ at different currents.

Conclusions

A 2DHG hosted in Ge/SiGe quantum well, with reasonably high mobility, simple band structure, and similar effective mass with GaAs two-dimensional electron systems, has proven to be a promising new system for the study of nonequilibrium magnetotransport [3].

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