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Microwave Photoconductivity of a High-Mobility 2D Hole Gas
Z.Q. YUAN, C.L. YANG, R.R. DU, Dept. of Physics, University of Utah; Dept. of Physics and Astronomy, Rice University, L.N. PFEIFFER, K.W. WEST, Bell Laboratories, Lucent Technologies — We have measured millimeter wave (frequency from 25 to 150 GHz) photoconductivity in a high-quality 2D hole gas (2DHG), and found characteristically different responses as compared to those from a 2D electron gas. The 2DHGs are provided by Si-doped, (311) GaAs/$Al_xGa_{1-x}As$ quantum wells (QWs), or C-doped, (001) GaAs/$Al_xGa_{1-x}As$ QWs, having a range of hole sheet density from 1 to 4.5 x $10^{11}/cm^2$, and low temperature (0.3 K) mobility from 2 to 6 x 10^5 cm^2/Vs. Magnetoresistivity, photoconductivity, as well as differential photoconductivity were measured using a low-frequency lock-in method at temperatures from 0.5 K to 1 K. Typically, differential photoconductivity data show a single peak corresponding to cyclotron resonance of 2D holes. In separate experiments we have measured the cyclotron absorption, from which we determined effective mass and scattering times of the 2DHGs. Our analysis shows that it is important to take into account the band structures of 2DHGs to understand the photoconductivity.

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