MAGNETOTRANSPORT IN (001) GaAs-AlGaAs HIGH-MOBILITY 2D HOLE SYSTEMS

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High-mobility 2D hole systems (2DHS) offer unique opportunities in studies of low dimensional physics primarily for the following reasons: 1) comparing with 2D electron system, 2DHS has different band structure parameters such as larger effective mass and significant nonparabolicity of the dispersion; 2) 2DHS possesses strong spin-orbit interactions. Using magnetotransport in a 33 T resistive magnet and at low temperatures to 50 mK, we have characterized a new type of high-mobility 2DHS in GaAs. The 2DHS is from a (001) GaAs/$Al_{0.4}Ga_{0.6}As$ quantum well grown by molecular beam epitaxy. The QW has a well width of 15 nm; holes are provided by a C delta-doping layer situated 50 nm away from the well. At low temperatures the 2D hole mobility can reach 6×10^5 cm^2/Vs at a density of $2 \times 10^{11}/cm^2$. With a potential gate we were able to increase 2D hole density to ~ $3.5 \times 10^{11}/cm^2$. Magnetoresistance around one-half filling show well-resolved high-order fractional quantum Hall states. These high magnetic field transport data have shown that 2DHS in C-doped (001) quantum wells exhibit exceptional quality as compared to the traditional Si-doped (311) quantum wells.

References

[1] S. Das Sarma, A. Pinczuk (Eds.), Perspectives in Quantum Hall Effects, Wiley, New York, 1997.