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Density dependence of mobility in a high quality Carbon-doped GaAs two-dimensional hole system JOHN WATSON, SUMIT MODAL, GABOR CSATHY, MICHAEL MANFRA, Purdue University, LOREN PFEIFFER, KENNETH WEST, Princeton University — Two-dimensional hole systems (2DHSs) in GaAs/AlGaAs heterostructures offer a unique platform for the study of the concomitance of strong Coulomb interactions and spin-orbit coupling. Recent advances in the growth by molecular beam epitaxy of Carbon-doped 2DHS in (001) oriented GaAs heterostructures have resulted in a substantial increase in the achievable low temperature mobility. Here we report on a systematic study of mobility in a series of high quality Carbon-doped (001) GaAs 2DHS samples. Several samples consisting of 16% AlGaAs barriers and 20nm GaAs quantum wells where grown with varying doping profiles to investigate the density dependence of mobility. Using an 80nm setback, a low temperature (T$\sim$50mK) mobility of 2.6x10^{6}cm^2/Vs at a density p=6.2x10^{10}cm^{-2} was observed. Surprisingly, samples with similar structural design but with a higher as-grown 2D density of 1x10^{11}cm^{-2} displayed a reduced mobility of 2.0x10^{6}cm^2/Vs. This behavior is distinct from that observed in high mobility two-dimensional electrons. In order to better understand the mechanisms influencing mobility in our 2DHSs we have studied the density dependence of mobility in a single sample using a backgate to modulate the density from 2x10^{10}cm^{-2} to 1x10^{11}cm^{-2}.

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