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Exploration of the Limits to Mobility in Two-Dimensional Hole Systems in C-Doped (001) GaAs/AlGaAs Quantum Wells[1] JOHN WATSON, Dept. of Physics and Birck Nano Center, Purdue University, W. Lafayette, IN, SUMIT MONDAL, Dept. of Physics, Purdue University, GEOFF GARDNER, Birck Nano Center and School of Materials Engineering, Purdue University, MICHAEL MANFRA, Dept. of Physics, Birck Nano Center, and Schools of Materials Engineering and Electrical and Computer Engineering, Purdue University — We report on the growth of a series of high mobility two-dimensional hole systems (2DHSs) in 20 nm (001) oriented GaAs/AlGaAs quantum wells and the analysis of possible scattering mechanisms. The hole density was controlled by changing the delta-doping setback and Al mole fraction and was measured at low temperature (T = 300 mK) after illumination with a red LED. We varied the density over a range from 2.0 x 10^{10} cm^{-2} to 1.9 x 10^{11} cm^{-2}, and the mobility was observed to peak at an intermediate density of 6.5 x 10^{10} cm^{-2} where we report a new record T = 300 mK mobility of 2.3 x 10^{6} cm^2/Vs . We find that even when the density dependent effective mass is taken into account, remote and background impurity scattering cannot qualitatively explain the behavior of the mobility, in contrast with comparable 2DEGs. We discuss possible mechanisms leading to the observed non-monotonic density dependence of the mobility and the factors leading to our new record mobility.

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