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Transport Measurement of Ultra-dilute 2D-Holes in High Quality (100) GaAs HIGFETs JIAN HUANG, D. C. TSUI, Princeton Univ, L. N. PFEIFFER, K.W. WEST, Bell Labs — We have studied transport properties of high purity p-channel GaAs HIGFETs and observed a surprising temperature dependence of conductivity (σ) at ultra-low densities from $p = 2 \times 10^{10} cm^{-2}$ to $p = 8 \times 10^{8} cm^{-2}$. For $p > 4 \times 10^{9} cm^{-2}$, as the temperature is decreased σ first decreases linearly with T, then exhibits a clear upward bending which signifies a metallic behavior. The temperature at which the bending occurs shifts to a lower value as p is decreased. However, the up-turning of σ weakens as the density goes lower until, at $4 \times 10^{9} cm^{-2}$, it becomes almost independent of T between 80mK and 40mK. As p is decreased from $4 \times 10^{9} cm^{-2}$ to $2 \times 10^{9} cm^{-2}$, σ continues to show little temperature dependence and tend to saturate at some finite values below $80mK$. Meanwhile, the high temperature linear regions become almost parallel to each other. As p is further decreased below $2 \times 10^{9} cm^{-2}$, the results are even more striking: the linear T-dependence persists even though the slope of the linear region starts to decrease. Remarkably, σ maintains the weak T-dependence below $80mK$. At $8 \times 10^{8} cm^{-2}$, σ retains a finite value of $0.045e^2/h$ at $40mK$. Consistent results were obtained through measuring three different samples. These observations contrast sharply with the metal-insulator-transition model which would predict a low-density insulating state, whereas we found no evidence of localization all the way down to the lowest density of $8 \times 10^{8} cm^{-2}$.

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