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Thermodynamic and transport properties of two-dimensional GaAs systems near the apparent metal-insulator transition E.A. GALAKTIONOV, G.D. ALLISON, A.K. SAVCHENKO, S.S. SAFONOV, University of Exeter, UK, M.M. FOGLER, UCSD, M.Y. SIMMONS, D.A. RITCHIE, Cavendish Lab, Cambridge, UK — An extensive study of the charge compressibility and resistance of two-dimensional electron and hole systems is reported. A total of five GaAs samples were examined, two 2DEGs and three 2DHGs. All samples have high mobilities but vary in spacer, doping, and other growth parameters. The inverse compressibility is found to have a negative minimum at a sample-dependent carrier concentration followed by an upturn to large positive values as the concentration decreases. This behavior is shown to agree quantitatively with the theory of nonlinear screening of the random impurity potential, for both types of carriers, despite a ten-fold difference in their r_s parameters. The region of the apparent metal-insulator transition (MIT) where $\partial R/\partial T$ changes sign, and the position of the inverse compressibility minimum can differ by as much as 50%. Their relative positions vary with sample and cooldown. No thermodynamic anomalies at the apparent MIT are detected. In a range of T where both the capacitance and the resistance of 2DHG samples were studied, the latter exhibits a scaling characteristic of the percolation transition. The corresponding percolation threshold is different from the MIT but agrees quantitatively with the percolation point deduced from the analysis of the compressibility.

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