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Incipient 2D Mott insulators in extreme high electron density, ultra-thin GdTiO3/SrTiO3/GdTiO3 quantum wells[1] S. JAMES ALLEN, DANIEL G. OUELLETTE, POUYA MOETAKEF, TYLER CAIN, RU CHEN, LEON BALENTS, SUSANNE STEMMER, UC Santa Barbara — By reducing the number of SrO planes in a $GdTiO_3$ /$SrTiO_3$/ $GdTiO_3$ quantum well heterostructure, an electron gas with $\sim$ fixed 2D electron density can be driven close to the Mott metal insulator transition - a quantum critical point at $\sim$1 electron per unit cell. A single interface between the Mott insulator $GdTiO_3$ and band insulator $SrTiO_3$ has been shown to introduce $\sim$ 1/2 electron per interface unit cell. Two interfaces produce a quantum well with $\sim 7\ 10^{14}$ cm^{-2} electrons: at the limit of a single SrO layer it may produce a 2D magnetic Mott insulator. We use temperature and frequency dependent (DC - 3eV) conductivity and temperature dependent magneto-transport to understand the relative importance of electron-electron interactions, electron-phonon interactions, and surface roughness scattering as the electron gas is compressed toward the quantum critical point. Terahertz time-domain and FTIR spectroscopies, measure the frequency dependent carrier mass and scattering rate, and the mid-IR polaron absorption as a function of quantum well thickness. At the extreme limit of a single SrO plane, we observe insulating behavior with an optical gap substantially less than that of the surrounding $GdTiO_3$, suggesting a novel 2D Mott insulator.

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