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Insulator-quantum Hall transition and Dirac fermion heating in low-carrier-density monolayer epitaxial graphene LUNG-I HUANG[1], YAN-FEI YANG[2], RANDOLPH ELMQUIST, DAVID NEWELL, National Instutute of Standards and Technology, CHI-TE LIANG, National Taiwan University — We present magneto-transport measurements on ungated, low-carrier-density epitaxial graphene Hall devices at low temperatures T. At T =4.25 K the carrier density and mobility of one device are 1.38x10^{11} cm^{-2} and 6500 $\mathrm{cm}^2\mathrm{V}^{-1}\mathrm{s}^{-1}$, respectively. At low magnetic fields B, this device shows insulating behavior in the sense that the measured resistivity $\rho_{\rm xx}$ increases with decreasing T. A highly developed quantum Hall (QH) resistivity plateau $\rho_{\rm xy} \approx \frac{h}{2e^2}$ corresponding to a Landau-level filling factor ν =2 in monolayer graphene can be observed at magnetic fields $B \geq 1.5$ T. Between the low-field insulator regime and the ν =2 QH state we observe a T-independent point in $\rho_{\rm xx}$ which corresponds to the insulator-quantum Hall (I-QH) transition. This transition, like those in semiconductor-based two-dimensional (2D) systems, can be also observed by increasing the driving current I at fixed ambient temperature. However, the measured $\rho_{\rm xx}$ at the I-QH transition is close to $\frac{h}{4e^2}$, rather than $\frac{h}{2e^2}$as expected by conventional I-QH theory. Furthermore, $\rho_{\rm xx}$ is substantially higher than $\rho_{\rm xy}$ at the crossing point. By using the zero-field resistivity and weak localization effect as two independent thermometers to determine effective Dirac fermion temperature (T_{DF}) at various I, we find that $T_{DF} \sim I^{0.5}$, consistent with those obtained in various 2D systems.

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