The Kubo-Greenwood expression and 2d MIT transport

THEODORE CASTNER, Univ. of Rochester — The 2d MIT in GaAs heterostructures (p- and n-type) features a mobility that drops continuously as the reduced density $n/n_c^{-1}$ is decreased. The Kubo-Greenwood result [1] predicts $\mu = (e\epsilon_h/\ln n_c)\alpha^2(x)$ where $\alpha$ is a normalized DOS. $\alpha(x)$ is obtained from the data [p-type, Gao et al. [2]; n-type Lilly et al. [3]]. Interaction corrections yield a Fermi energy $E_F = E_c[x-A_{HF}x^{1/2}/\gamma + A_{CT,ic}x^{1/4}/\gamma^{3/2}]$ where $E_c = n_c/a^2$ with $a$ the non-interacting DOS and $\gamma = (2\pi n_c)^{1/2}a^*$, $A_{HF}$ is a Hartree-Fock term, while $A_{CT,ic}$ is a repulsive interaction term between the charged traps (CT) and the itinerant carriers (ic) that are confined in conducting filaments. $N(E_F,x)$ is determined using $N(E)dE=2kdE/2\pi$ where $k_F=(2\pi n_c x)^{1/2}$. The data determines the “self-energy” terms $A_{HF}$ and $A_{CT,ic}$. The effective mass $m^*(x)$ is given by $m^*(x)/m_b^* = 1/\alpha(x)$ and diverges as $x^{-3/4}$ as $x$ goes to zero at $T=0$. $\alpha(x)$ goes to 1 for large $x$. The interaction approach will be compared with the percolation approach. [1] Mott and Davis, Elect. Prop. in Noncryst. Mat. [Clarendon Press 1971]; [2] Gao et al. PRL93,256402 (2004); [3] Lilly et al. PRL90,056806 (2003)

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