Gate-Induced Carrier Delocalization in Quantum Dot Field Effect Transistors\textsuperscript{1} M.E. TURK, J.-H. CHOI, S.J. OH, A.T. FAFARMAN, B.T. DIROLL, C.B. MURRAY, C.R. KAGAN, J.M. KIKKAWA, University of Pennsylvania — We study the low temperature resistance and magnetotransport of high-mobility indium-doped CdSe quantum dot (QD) field effect transistors [1]. Low temperature resistance measurements show a characteristic dependence of $R(T) = R_0 \exp \left( \frac{T_0}{T} \right)^p$ with $p = 2/3$, consistent with a recent model based on Coulomb gap variable range hopping plus thermal broadening. We show that using the gate bias $V_G$ to accumulate electrons in the QD channel increases the “localization product” $\kappa a$ (localization length $a$, dielectric constant $\kappa$), as expected for Fermi level changes near an Anderson mobility edge. Under any reasonable assumptions, $a$ increases significantly beyond the QD diameter as gate bias is applied. Magnetoresistance (MR) measurements display both positive and negative MR contributions that vary with $V_G$ and $T$. For each $V_G$, we observe a universal negative MR lineshape for higher temperatures ($T > 20K$) that scales as $T^{-4/3}$, consistent with Zeeman MR for $p = 2/3$ with a gate bias-modulated mobility gap ($\Delta \varepsilon$).


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