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Gate-Induced Carrier Delocalization in Quantum Dot Field Effect Transistors[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 $R(T) = R_0 \exp{(T_0/T)^p}$ 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" κa (localization length a, dielectric constant κ), 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 ($T > 20$K) that scales as $T^{-4/3}$, consistent with Zeeman MR for $p = 2/3$ with a gate bias-modulated mobility gap ($\Delta\varepsilon$).

[1] Turk, *et al.*, Nano Lett., 14, 5948 (2014)

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