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Muli-state operation in quantum dot channel FETs incorporating spatial wavefunction-switching[1] F. JAIN, K. BASKAR, S. KARMAKAR, P-Y. CHAN, E. SUAREZ, B. MILLER, J. CHANDY, University of Connecticut, E. HELLER, RSoft Design Group — Three-state behavior has been demonstrated in Si and InGaAs quantum dot gate (QDG) field-effect transistors[2,3] (FETs). Recently, spatial wavefunction switched[4] (SWS) and quantum dot channel[5] (QDC) FETs have been reported to exhibit four-state operation. This paper presents simulations of versatile combinations of SWS features in QDC channels to optimally design multi-state transport in FETs that have the potential of scaling to sub-12nm regime. A QDC-FET channel is modeled as having superlattice-like mini-energy bands where the carrier wavefunctions are transferred across the channel as drain voltage is changed, producing step-like multi-state electrical characteristics. This behavior is analogous to that of single electron transistors.[6] The difference is that QDC devices use more than a few electrons and operate at room temperature. The SWS feature additionally provides carrier transfer from lower to upper dot layer(s) in a QDC having more than one layer of quantum dots.

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[2]S. Karmakar, *et al.*, J. Electronic Materials, 40, 1746, 2011.
[3]F Jain, J. Electronic Materials, 40, 1717, 2011.
[4]Ibid.
[5]F. Jain et al., Proc. II-VI Workshop, Oct.2011.
[6]S. J. Shin, et al., Appl. Phys. Lett. 97, 103101, 2010.

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