Quantum Dot Channel FETs harnessing Mini-Energy Band transitions in GeOx-Ge QDSL for Multi-Bit Computing

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Abstract - Vertically-stacked 2 quantum dot channel (QDC)-FETs exhibit 4-state characteristics at room-temperature. This paper presents pathway to obtain 8- and 16-states, as an alternative to sub-milliKelvin Si/SiGe qubits.

Innovation:
Coding of multiple states via:
• Intra-sub band transitions in Ge quantum dot channel (QDC) FETs quantum dot superlattice (QDSL),
• Spatial switching of carrier wavefunctions from lower quantum dot channel QC2 to upper channel QC1,
• Tunneling to QDs in the gate region.

Experimental data

Fig. 3 (a) Si QDC-FET ID-VD showing transport in three mini-energy bands.

Fig. 1(a) Mini-energy band of GeOx Ge quantum dot (4nm) QDSL.
Fig. 1(b) Density of states (DOS) in mini-energy bands.
Fig. 2 Carrier density vs Fermi level showing mini-energy sub-bands.
Fig. 3 (b) Si QDC-SWS-FET ID-VD showing carrier switching from QD2 to QD1.

Fig. 4 Ge QDC-FET with mini-energy band transport and SWS encoding 8-state operation is based on the drain current, which depends on the number of mini-energy bands in transport quantum channel (QC) and transfer via tunneling between lower (QC2) and upper (QC1) channels.

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