

Abstract Submitted  
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**Electronic-structure modulation transistor: A new switch with few kT supply voltage** HASSAN RAZA, School of Electrical and Computer Engineering, Cornell University, Ithaca NY, 14853, TEHSEEN RAZA, School of Electrical and Computer Engineering, Purdue University, West Lafayette, IN 47907, TUO-HUNG HOU, Department of Electronics Engineering, National Chiao Tung University, Hsinchu, Taiwan 300, ROC., EDWIN KAN, School of Electrical and Computer Engineering, Cornell University, Ithaca NY, 14853 — We present a novel electronic-structure modulation transistor (EMT) for post-CMOS logic applications. The device is based on the electronic structure modulation of the channel by an external gate voltage. Its functionality is theoretically analyzed using single-band tight-binding model and non-equilibrium Green's function formalism. We report that the EMT is expected to have very large ON/OFF current ratio with reasonable self gain using a few kT Vdd. We provide an experimental proof-of-concept device of the proposed mechanism in a double gated structure using a 20 nm long and 10 um wide channel consisting of Au nanocrystals (NCs) and nitride traps. Putting negative charge on the NCs is results in wavefunction extension over larger distance due to lifting of the energy levels, resulting in reduction of the effective barrier. In transfer characteristics, we find a nonlinear dependence of the drain current on gate voltage and charge stored in the channel, which we attribute to the wavefunction modulation of the Au NCs due to charging.

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