NANO HIGHLIGHT
Collective Computation with Self Assembled Quantum Dots, Nanowires and Nanodiodes: A Novel Paradigm for Nanoelectronics

NSF NIRT Grant 0506710

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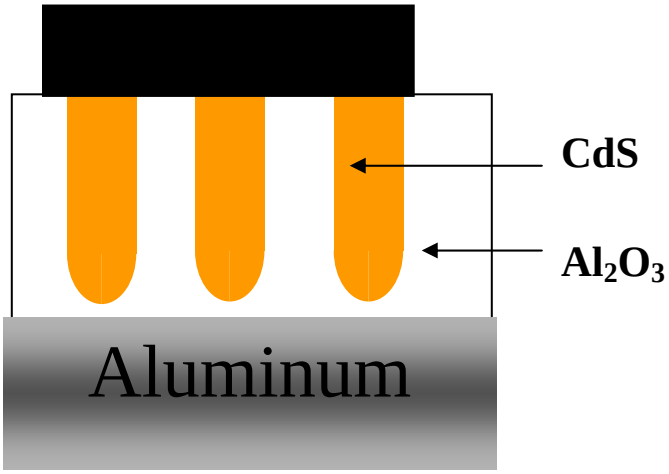
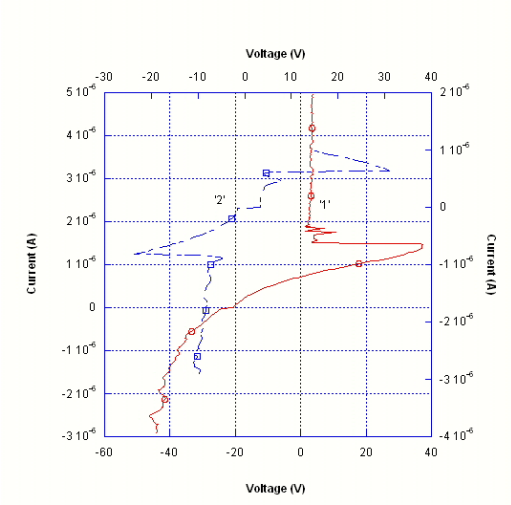
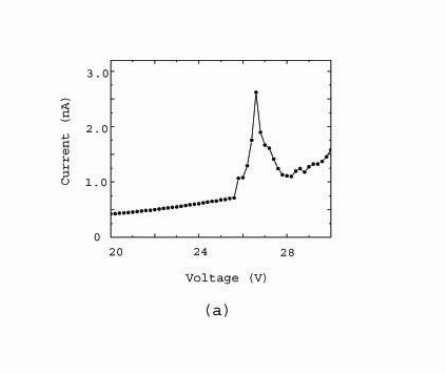
The purpose of this project is to develop self assembled networks of interacting quantum dots, nanowires and nanodiodes for collective computation [1-3]. One of the primary requirements to elicit computational activity is that the nanowires exhibit a negative differential resistance. We have recently self assembled nanowires in a metal-insulator-semiconductor diode configuration, hosted in a nanoporous ceramic matrix. The cross section of the structure is shown below





This structure exhibits an S-type non-linearity with a pronounced negative differential resistance as shown in the right panel. The room temperature peak to valley ratio is 19:1. That makes these structures eminently suitable for the proposed architecture.

We have also observed N-type negative differential resistance in some nanowires. The peak to valley ratio associated with the N-type characteristics is smaller (2.5:1), but adequate for the circuit paradigm to work. The N-type characteristic is shown below.



References

1. V. P. Roychowdhury, D. B. Janes, S. Bandyopadhyay and X. Wang, IEEE Trans. Elec. Dev., 43, 1688 (1996).
2. V. P. Roychowdhury, D. B. Janes and S. Bandyopadhyay, Proc. IEEE, 85, 574 (1997).
3. K. Karahaliloglu, S. Balkir, S. Bandyopadhyay and S. Pramanik, IEEE Trans. Elec. Dev., 50, 1610 (2003).