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NANO HIGHLIGHT
Radially Encoded Nanowires

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PIs: **André Dehon[1]**, **Charles M Lieber[2]**, **John E Savage[3]**
[1]California Institute of Technology, [2]Harvard University, [3]Brown University

The crossbar has emerged as an important architectural element in memories and logic devices made from nanometer-sized materials. (Nanowires (NWs) have been exhibited with diameters as small as a few nanometers and lengths ranging from microns to millimeters.) The nano-crossbar has two orthogonal sets of parallel wires separated by a layer of self-assembled molecules. The electronic state of these molecules can be switched by a large electric field and sensed, but not changed, by a smaller field. The molecules at a crosspoint formed by a pair of orthogonal NWs are set or read by activating only those two NWs. This requires that individual NWs along each dimension of the crossbar be addressable using a small number of meso-scale wires (MWs). Several methods for addressing many NWs with a small number of MWs have been proposed. Some methods manufacture many types of differentiated NWs then deposit a mixture of them on a chip. Others grow undifferentiated NWs directly on a chip and then differentiate them stochastically. In either case, circuits (called decoders) are implemented that allow a few MWs to control many NWs with high probability.

Our analysis suggests that the most promising decoders are those using **radially encoded NWs** [2]. These NWs are differentiated by adding differentially etchable shells to a lightly doped core. When shells are selectively removed by etching, NW cores are exposed to MWs, as indicated in the simple decoder in Fig. 1. NWs are made parallel and deposited on a chip fluidically. Repeating the process twice at right angles creates a crossbar. For radially encoded NWs to remain competitive with other NW technologies, they must not use more than a few shells (shells increase NW diameter). Our recent analysis [3] and unpublished Monte Carlo experiments show that 50% to 75% of NWs are addressable using as few as 12 different shell sequences. Twelve shell sequences are achieved with only four etchable materials and two shells.

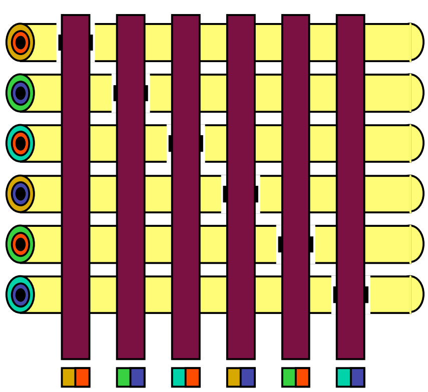

Fig. 1 Applying immobilizing fields to all but one vertical MW causes all but one horizontal NW to be conducting.

References

[1] For further information about this project send email to **<John_Savage@brown.edu>**

[2] Radial Addressing of Nanowires, John E. Savage, André DeHon, Charles M. Lieber, and Yue Wu, submitted to ACM JETC.

[3] Evaluation of Design Strategies for Stochastically Assembled Nanoarray Memories, Benjamin Gojman, Eric Rachlin, and John E. Savage, ACM JETC, Vol. 1, No. 2, pp. 73-108, July 2005.