CONNECTING NANO TO THE OUTSIDE WORLD: A VIDEO DISPLAY COMPOSED OF MILLIONS OF ADDRESSABLE NANODEVICES

Kenneth A. Dean
Motorola, Inc.,
2100 East Elliot Road, Tempe, AZ U.S.A

Nanotechnology is enabling a new type of flat screen display for reasons that are counterintuitive to mainstream thinking. For this application, small diameter carbon nanotubes having properties far superior to alternative materials can be fabricated easily and placed chemically. Using these nanometer-sized tubes actually allows us to make the control electrodes and surrounding device structure larger and less precise. The combination of an inexpensive, chemically-placed nanomaterial, and a simple device structure with large features results in low fabrication costs. The manufacturing costs are predicted to be low enough that displays larger than 40 inches (~ 1 meter) in diagonal can be built and sold at attractive prices. While most nanotechnology enables smaller and faster devices, in this case, the smallest nano-sized materials look well-suited to enable large, meter-sized displays.

The development of large area displays also demonstrates successful implementation of several complexity levels in nanotechnology. These are: 1) Basic nanomaterial physics, 2) Nanotube devices (three electrodes), and 3) Interconnection of thousands of devices to external driving electronics and optical components (i.e.interoperability with the outside world). The third complexity level, interoperability, is currently at the infancy stage in nanotechnology. Nanotube-based displays are one of the first devices to demonstrate robust and reproducible connections of millions of devices to the outside world. In fact, our displays demonstrate the simultaneous operation of several million three-terminal nanotube devices with a performance variation of less then 10% between them.

In this presentation, we focus on the challenges of interoperability in nanotechnology applications. We discuss our evolution from nanotube physics to single three-terminal devices to successful integration into a QVGA resolution display complete with CMOS drivers and video screens. We will detail several clever engineering approaches which were helpful in realizing working devices including, stochastic placement of the nanomaterials, statistical averaging, simple architectures, matrix addressing and optical outputs. Our engineering approaches are likely to be applicable to other types of nanodevice technologies.

In addition, we will discuss the large variation in the way that researchers have measured and reported results in this field. These differences made comparisons between researchers difficult, and more importantly, they encumbered discussions with potential partners. We suggest a route to better communication and reporting.