Nanotechnology in Electronic and Sensor Application

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As a replacement for silicon CMOS at the end of scaling according to Moore's law, transistors based on carbon nanotubes and graphene have been explored by a number of groups across the world. In contrast, we have developed nanoscale vacuum tubes or transistors. Vacuum tubes went away because they were bulky and consumed a lot of power while integrated circuit (IC) manufacturing allowed producing devices with ever-decreasing features sizes. However, vacuum is superior to any semiconductor in terms of electron transport due to absence of collisions. We have taken advantage of this and standard IC processing steps to construct nanoscale vacuum transistors. A plasma ashing step is critical to create the emitter-collector gap to the desired level. Preliminary results for a gap of 150 nm show 0.4 THz performance and further scaling down can provide frequencies well into the THz regime.

We have also made progress on flexible electronics. Preliminary results on oxide nanowire based transistors and memory devices for e-textile, and sensors fabricated on cellulose paper will be presented. Carbon nanotubes can be easily ink jet printed on paper to create gas/vapor as well as biosensors. Preliminary results from these efforts will be presented.

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