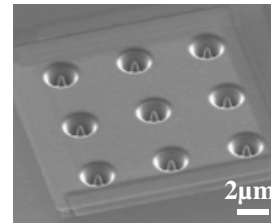
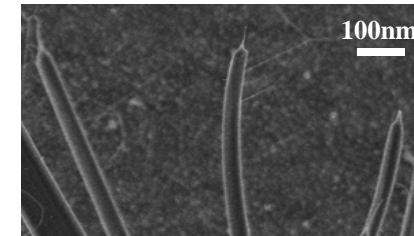


## Goals and Potential Impact if Successful

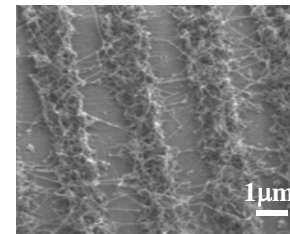
- Develop novel techniques for controlled fabrication of triode-type nanotube and nanowire field emitter arrays
- Reduce the required voltage, enable the modulation of the emission current, and provide more control for small arrays such as the pixels in flat panel displays.
- Create new field emission sources with improved gate voltage, long lifetimes, and high stability of emission current in comparison to those of conventional metal and silicon field emitters.
- Promote the potential applications in high frequency amplifiers, high frequency traveling wave tubes, flat panel displays, multiple electron beam lithography, and portable x-ray sources.



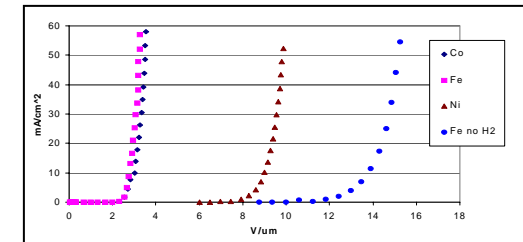
Nanoemitter arrays fabricated by FIB



SiO<sub>2</sub> nanowire emitters



Controlled growth of nanotubes in column structure



I-V characteristics of nanotubes synthesized from different catalysts

## Approach and/or Accomplishments

### Nanofabrication:

- Optimize synthesis conditions for high quality nanotubes and nanowires
- Fabricate micro-gated nanotube and nanowire emitter arrays of various configurations using combined FIB and CVD technique
- Explore procedures for the scaling issues

### Electrical Property Characterizations:

- Evaluate the field emission behavior of the emitter arrays
- Measure the gate to cathode capacitance
- Investigate the interface effects between the nanotubes, nanowires and the substrate

## Bottlenecks and Open Research Questions

- There exists a lack of reliable techniques for controlled growth of nanotubes and nanowires
- Existing techniques for fabricating nanodevices are inadequate for reliable mass production of nanotube- and nanowire-related devices
- When fundamental nanomaterials science problems are still critical, nanodevice fabrication is even more difficult
- How to establish a strong tie among the materials scientists, theoreticians, and device engineers to ensure the realization of the nanodevice technology?