Project Overview - Objectives

- Develop an integrated manufacturing process to connect nanostructures with larger scale systems.
- Further characterize process to enhance yield, material characteristics.
- Study CNT material, electrical, thermal, and mechanical properties.
- Determine the relationship between growth conditions and physical properties.
- Design of CNT-based sensors and transducers.
Process Review

(a) Silicon Oxide Substrate
(b) Etched Silicon
(c) Oxide Etch
(d) Catalyst
(e) $\text{C}_2\text{H}_4$
(f) E

Past Results

E

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Progress

+42.5V  +40V

ground

10 μm

Progress

2 3 4 5,6 10 um

ground

+42.5V  +40V

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CNT I-V Characteristic

CNT-Microstructure
Mechanical Contact Strength
CNT-Microstructure
Mechanical Contact Strength
CNT Inspection

200 nm

CNT Inspection

100 nm
Results

- Carbon Nanotubes driven to connecting nearby microstructures.
- Excellent electrical contacts – linear I-V behavior as expected.
- Initial sensing demonstrated – N₂ pressure changes differential resistance by 13%.
- Mechanical contacts stronger than nanotubes in most cases.
- TEM analysis: Largely base growth, Multi-walled tubes, 3-24 nm diameter seen.

Future Work

- Further process analysis and modification
  - Achieve single-walled tubes.
  - Tip growth.
- Design for application in biological and gaseous sensing.

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