

Carbon Nanotube Acoustic Sensors for NDE

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Objectives

- Investigate capability of carbon nanotube (CNT) strain sensors for reception of ultrasonic waves.

Approach

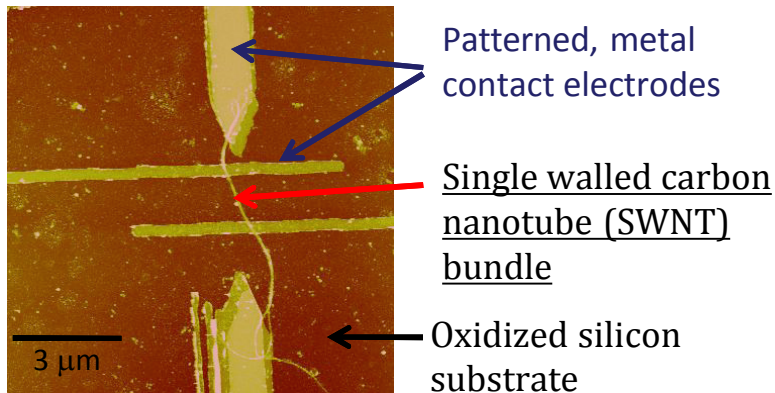
- Measure and simulate response of CNT sensors to ultrasonic waves.
 - Examine frequency response and directionality
- Use these measurements and validated simulations to establish guidelines for future CNT acoustic sensor research and development

Benefits/Payoffs

- Benefits are :
 - Reduced sensor weight
 - Possible increased sensitivity over traditional acoustic transducers
- Payoff
 - Establish capabilities of CNT based sensors for receiving acoustic waves
 - Increase application of nanotechnology for NDE
- Customers that would benefit from the system:
 - ARES
 - CONSTELLATION Program
 - Aviation Safety Program
 - ISS

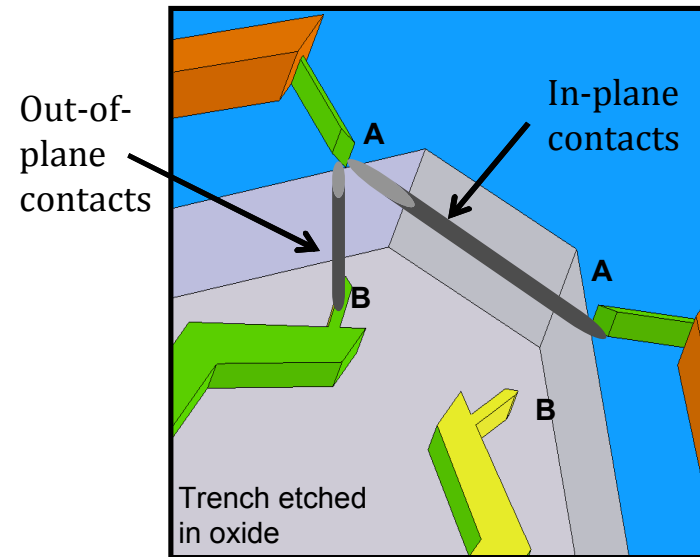
Carbon Nanotube Strain Sensors

- CNT strain sensors have been developed that utilize piezoresistive property of single walled CNT
 - Sensors are directional; many configurations are possible



Smits, J. M. (2005). "Strain Sensitivity in Single Walled Carbon Nanotubes for Multifunctional Materials", NASA/CR-2005-213272.

SWNT sensor design. Nanoscale contacts allow measurement of electrical conductivity response of nanotubes to external environment (temperature, strain, etc.)



Multidimensional sensor structure. In-plane and out-of-plane connections permit measurement of 3D strain measurement

- Perform measurements and simulations to evaluate sensor response to acoustic waves

Schedule

Identification of initial sensor and test specimen designs	12/2010
Construction of sensors and test specimens	6/2011
Measurements performed with initial sensors and specimens	9/2011
Simulation of sensor response	12/2011
Adjust simulation parameters to give good agreement with experimental measurements	3/2012
Use simulation to modify sensor design and manufacture additional specimens	9/2012
Measurements on new sensors	2/2013
Compare responses of sensor designs and establish applicability of sensors for acoustic wave reception	6/2013
Final report	9/2013

Conclusion

- This task will determine the potential of CNT acoustic sensors for NDE applications and provide the basis for future research and development work.