

## Carbon Nanotube Materials Tailored for Wiring

Supporting/Contributing Agency: National Reconnaissance Office

Space Power research and development efforts with the Rochester Institute of Technology (RIT) NanoPower Research Labs are dedicated to the development of nano-materials and devices for power generation, conduction, and storage.

In systems where weight reduction is essential, and valuable (commercial aircraft, satellites, and military fighters), weight trimming exercises quickly turn to means to replace copper-based wiring. As an example, 12% of a satellite's dry mass weight results for the copper-based signal and power harnesses. It is estimated that a single signal harness weighing 600 pounds could be reduced to 200 pounds if carbon nanotube (CNT) wiring replaced copper. The overarching goal for this nanotechnology R&D is to manufacture articles utilizing well characterized high quality CNT materials and subject them to a series of tests to determine the fundamental properties of CNT-base wires and co-axial cables and their behavior in simulated space environments.

The focus of the CNT for wiring R&D is to:

- increase conductivity of wires made from carbon nanotube ribbons and threads
- demonstrate durable contact materials for termination
- demonstrate insulation and co-axial CNT wire production
- test the physical properties of CNT wires in simulated space environments

R&D goals were achieved and a 37 mm long coaxial CNT wire was constructed. The inner conductor consists of a 0.60 mm diameter densified CNT wire. This inner conductor exhibits an overall resistance of 4.5 ohms along its entire length, as measured with a 2 probe technique. Transparent polyolefin was used to insulate this wire from the outer CNT conductor. The outer co-axial conductor was produced from the same CNT sheet material. The diameter of this outer conductor was 1.3 mm. A larger diameter of polyolefin heat shrink tubing was used to complete the coaxial wire with a final diameter of 2.8 mm.



**Figure 1.** Images of the coaxial wire fabricated in the RIT NanoPower Research Labs

### References/Publications

Rafelle, R. and Landi B., CNT Spacecraft Harness Report, Chantilly, VA, 7 April 2009.