Cable Harnesses from Carbon Nanotube Materials

Supporting/Contributing Agency: National Reconnaissance Office

The Aerospace Research Laboratories at Northrop Grumman Aerospace Systems established a national level R&D team consisting of academia and industrial assets to provide both material performance and production advances to enable the commercialization of continuous carbon nanotube yarns and sheets to enhance future space and avionic missions. Research goals included: 1) establishing and scaling-up of high volume production methods for carbon nanotube (CNT) growth; 2) CNT fiber spinning; 3) CNT yarn processing and weaving, 4) CNT product definition; 5) product performance verification; and, 6) demonstration of applicability to space use. The government's R&D objectives included the creation a new generation of extremely lightweight and highly conductive wiring harnesses for space and avionic missions.

R&D successes have resulted in CNT wires with resistance specifications that meet command and telemetry signal requirements. Present CNT conductivity enhancement levels permit braided materials to be used for high speed/reliability digital signal transmission applications with data rates approaching USB 2.0 standards. Additionally CNT sheets offer lighter weight and electromagnetic interference (EMI) benefits over tin-copper shielding braid. Thus, this R&D will allow near term insertion in satellite systems with a long-term potential for a two-thirds weight savings for CNT coax cables and power harnesses. Table 1 shows current noteworthy achievements.

Table 1. Current State of CNT Wire Harness R&D

Property	Current Achievement	Relevance
Resistance	< 50 μΩ-cm vs. 1.7 μΩ-cm Cu	Permits high speed/reliability digital signal transmission
EMI shielding	> 80dB	Enables electromagnetic interference protection
Manufacturing Development	Fabricated 28 AWG and 22 AWG CNT wires using industry braiders	No special wiring manufacturing equipment required
Applications Development	Demoed data integrity of a CNT USB 2.0 cable	Integration path established for command and telemetry signals

The Figures below indicate a state of readiness for use in manufacturing. Ongoing R&D continues to tailor the CNT properties to permit full spectrum replacement where advantage is achieved by light-weight wiring. R&D will continue on CNT property tailoring—but the key need now is CNT material production scale-up to allow very high volume manufacturing.

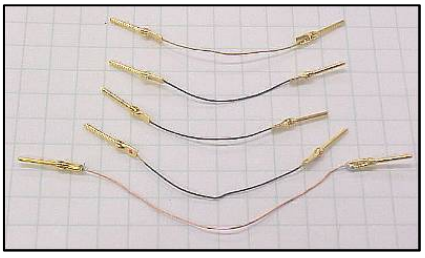

Figure 1. CNT wires use standard connectors

Figure 2. World's first CNT USB cable

Figure 3. Satellite wiring test facility

References/Publications

Silverman, E., Conductive Carbon Nanotube Yarns and Sheets for Spacecraft Power and Signal, Chantilly, VA, 14 January 2009.