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# CNT-POLYIMIDE NANOCOMPOSITES FOR SPACE APPLICATIONS

**Abstract**

Polyimide (PI) is extensively used on the exterior of spacecraft as a thermal control blanket due to its durability to space environment hazards and unique chemical, thermal and mechanical characteristics. Since PI is an insulating material, when exposed to space plasma, electrostatic charge accumulates on its surface and may cause an electrostatic discharge (ESD) followed by physical damage and electronic systems failure. A common solution is imparting a surface conductivity to insulating polymer films by depositing electrically conductive coatings, such as, Indium tin oxide (ITO). However, the deposition of ITO coating on the PI surface diminishes the flexibility of the film since ITO is brittle and cannot tolerate folding or bending into small diameters. Therefore, many efforts are focused on increasing the bulk conductivity of PI. One of the methods involves the incorporation of conductive fillers, such as carbon nanotubes (CNTs) in the PI matrix.

The objective of this work is to develop flexible CNT-PI nanocomposite films for ESD protection in space environment. To prevent CNT agglomeration and control their distribution, chemical vapor deposition (CVD) grown CNT sheets were used rather than CNT powder in dispersion. Thin and flexible nanocomposite films were synthesized by infiltration of PI solution into the entangled CNT sheets. The CNT-PI films exhibited ohmic electrical conductance in both lateral and vertical directions. A sheet resistivity as low as 122 / was obtained. Owing to the fabrication method, the electrical conductivity of the CNT-PI films was similar to that of as-grown CNT sheets, with minimal effect of the insulating PI matrix. Moreover, the conductivity of the CNT-PI films was preserved under mechanical and thermal manipulations. These properties make the reported CNT-PI films excellent candidates for applications where flexibility, thermal stability and electrical conductivity are required. Particularly, the developed CNT-PI films were found durable to space environment hazards such as, vacuum, thermal cycling, ionizing radiation and hence they are suggested as an alternative for electrostatic discharge (ESD) protection layer in thermal blankets of spacecraft.