National Aeronautics and
Space Administration

technology solution

Materials and Coatings

Dispersion of Carbon Nanotubes in Polymers

For making stable resin dispersions and composite plastic films, and for standard polymer melt processing

NASA's Langley Research Center researchers have developed an extensive technology portfolio on novel methods for effective dispersion of carbon nanotubes (CNTs) in polymers. The technology portfolio extends from making stable dispersions of CNTs in polymer resins to processes for making composite CNT/polymer films and articles. The technologies apply to a range of polymer types, enable low or high CNT loadings as needed, and can be used with a variety of standard polymer processing methods, including melt processing. Currently, the technology is being used commercially for electrically conductive polymer films for components in electronic printers and copiers.

BENEFITS

- Uniform, non-agglomerated dispersion of CNTs in polymers for:

  -- improved optical transmission of the nanocomposite
  -- long-term stability in resins
  -- high CNT loadings
  -- custom process that can be optimized for the polymer system of interest
- Useful for making CNT composite films and composite parts via a variety of standard polymer processing methods
- No degradation of the CNTs
- Excellent bonding characteristics at the CNT/polymer interface
- Extensive experience base available for guidance and support

THE TECHNOLOGY

The technology portfolio spans several methods for dispersion and processing of CNTs in polymer resins and composites. CNT/resin systems with high dispersion and long-term stability are provided by three general approaches. One method relies on mechanical dispersion by sonication simultaneous with partial polymerization to increase the resin viscosity to maintain dispersion and enable further polymer processing of the CNT blend into films and other articles. Another approach relies on what is termed donor acceptor bonding, which essentially is a dipole bond created on the CNT/resin interface to maintain dispersion and stability of the CNT/resin blend. This dispersion method also provides advantages in mechanical properties of processed composites due to the interface characteristics. A range of polymer types can be used, including polymethyl methacrylate, polyimide, polyethylene, and others.

An additional dry blending approach provides advantages for a variety of thermoplastic and thermoset systems. Use of ball mill mixing achieves effective blending and dispersion of the CNT, even at high loadings. Further processing steps using injection molding or similar melt processing methods have yielded CNT/polymer composites with a range of useful electronic, optical, and mechanical properties.

The NASA technology could be utilized in a wide variety of materials.

APPLICATIONS

The technology has several potential applications:

- Conductive plastics
- Displays - liquid crystal displays, organic light-emitting diodes, touch screens, flexible displays
- Solar cells
- Conductive inks
- Static control materials, including films, foams, fibers, and fabrics
- Polymer coatings and adhesives
- High performance polymer composites and prepregs for exceptional mechanical strength and toughness
- Polymer/CNT composite fibers
- Lightweight and antistatic materials for use in space structures

PUBLICATIONS

Patent No: 7,906,043; 7,588,699; 7,972,536; 7,666,939

Patent Pending

More Information

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