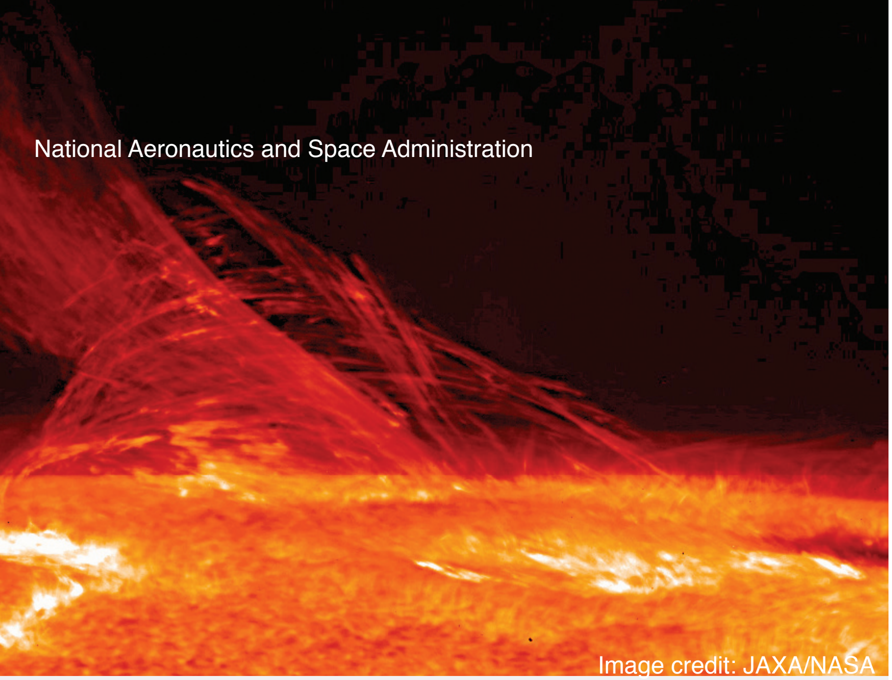

Image credit: JAXA/NASA

Materials and Coatings

Novel Aromatic and Aliphatic Diamines

For advanced polymer applications

NASA's Langley Research Center chemists have synthesized a class of novel diamines for epoxy resins that possess both aromatic and aliphatic characteristics. These molecules have been shown useful in two unrelated areas. First, the diamines have been demonstrated to aid in the dispersion of carbon nanotubes into polymer matrices. Single-walled carbon nanotubes (SWNT) have countless applications, but their utilization has been somewhat impeded due to their inability to interface with polymers and due to the bundling of the tubes. The diamine molecules enable SWNT to be dispersed in a polymer and inhibit nanotubes bundling. Secondly, composite materials containing the diamines possess the ability to provide both structural and radiation-shielding functions. Because the diamines are both aliphatic and aromatic, they are endowed with the dual properties of high hydrogen content and high strength, which are particularly well suited to radiation-shielding applications.

BENEFITS

- Aid in the dispersion of carbon nanotubes in polymer matrices
- Possess both aromatic and aliphatic characteristics
- Provide structural and radiation-shielding functions in a composite material
- Have the unusual combination of high hydrogen content and aromatic groups
- Produce composite materials that are nonleaching
- Technology encompasses a diverse set of molecules

technology solution

THE TECHNOLOGY

Aromatic/aliphatic diamines are incorporated into structural epoxy formulations in a traditional cross-linked network. Within the diamine molecules, the aliphatic region is covalently bonded to the aromatic region in a pendant fashion at the carbon bridge. Consequently, the aliphatic region does not take part in the cross-linking molecular network and gives the molecules their unique properties. In SWNT composite applications, the aliphatic groups help to minimize the van der Waals interaction between neighboring nanotubes and prevent bundling. In radiation-shielding applications, these aliphatic groups provide the high hydrogen content necessary for a shield application to be effective at screening against heavy ion radiation. However, the addition of the aromatic moieties renders the molecules stronger than other high hydrogen content polymers such as polyethylene, which lack the stiffness to perform as shielding and structural materials. The unique properties of these molecules make them likely candidates as well for other applications that cannot be anticipated.

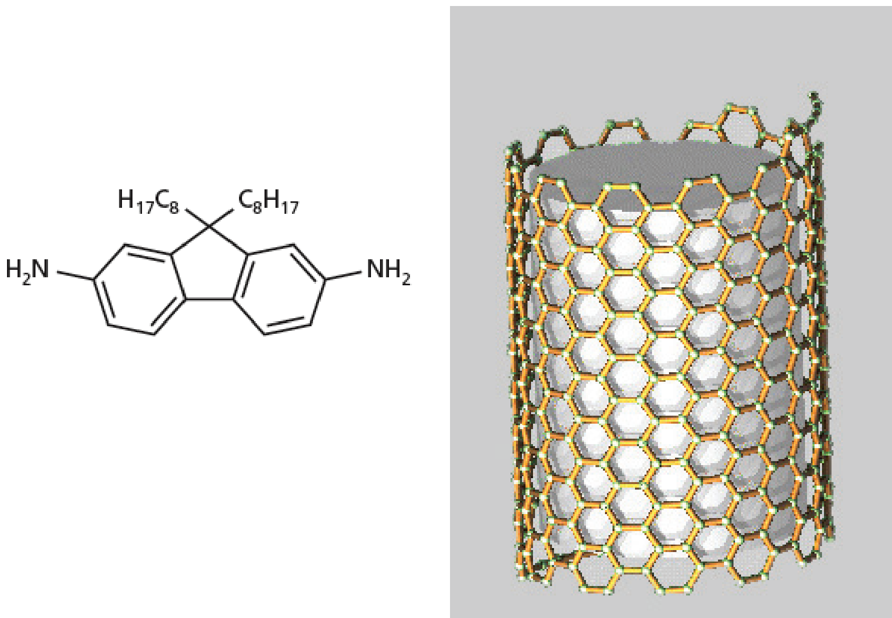

FIGURE – Examples of one of the synthesized diamines

APPLICATIONS

The unusual characteristics of these molecules make them likely to see broad applications, including:

- Single-walled carbon nanotubes composite materials
- General chemistry
- Radiation shielding

More Information

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