



National Aeronautics and
Space Administration



TECHNOLOGY SOLUTION

Materials and Coatings

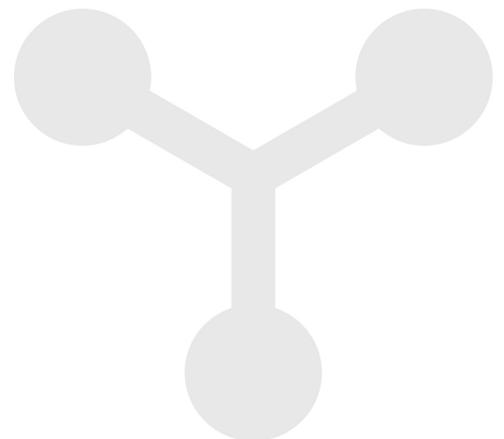
New Resin Systems for Thermal Protection Materials

[A unique approach to making a carbon reinforced ablator.](#)

This innovation focuses on an improved low density ablator with improved structural performance and high temperature capability. A new polymer system consisting of cyanate ester and phthalonitrile resins were used to create this carbon reinforced ablator. Cyanate ester resin is a thermoset resin which has high char stability, high decomposition temperature, low oxygen content, low moisture absorption and high glass transition temperature (400 degrees Celsius). Phthalonitrile resin is another type of thermoset resin which has very high char stability, and high decomposition temperature (480 degrees Celsius).

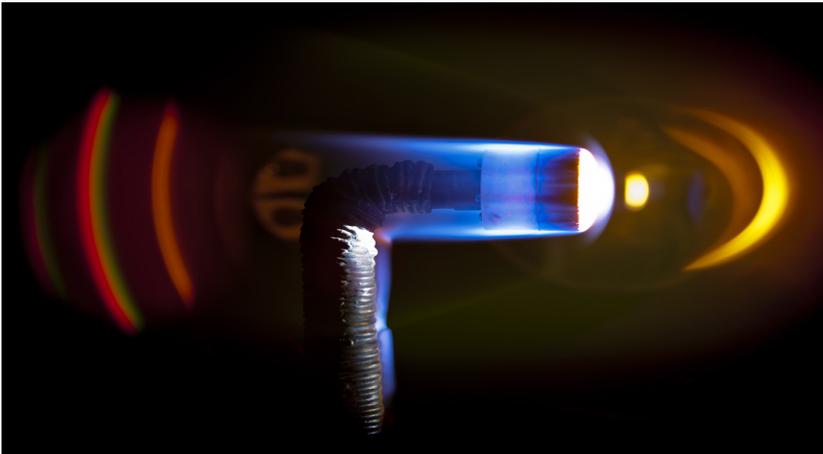
BENEFITS

- Increase in the char yield
- Enhanced char stability
- Increased thermal stability
- Increased glass transition temperature



THE TECHNOLOGY

This method produces a low density ablator similar to Phenolic Impregnated Carbon Ablator (PICA) using a cyanate ester and phthalonitrile resin system, rather than the heritage phenolic resin. Cyanate ester resin systems can be cured in a carbon matrix and generate high surface area structure within the carbon fibers. This helps to reduce the thermal conductivity of the material which is one of the key requirements of thermal protection system (TPS) materials. The material has densities ranging from 0.2 to .35 grams per cubic centimeter. NASA has successfully processed the cyanate ester and phthalonitrile resins with a morphology similar to that of the phenolic phase in PICA, but with more advanced properties such as high char stability, high char yield, and high thermal stability. This new generation of TPS materials has the same microstructure as heritage PICA, but improved characteristics of PICA such as increased char yield, increased char stability, increased thermal stability and increased glass transition temperature.



Material Ablation Test

APPLICATIONS

The technology has several potential applications:

- Space exploration
- Systems engineering
- Thermal Protection Systems
- Materials engineering
- Mechanical engineering

PUBLICATIONS

Patent No: 10,717,836

More Information

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