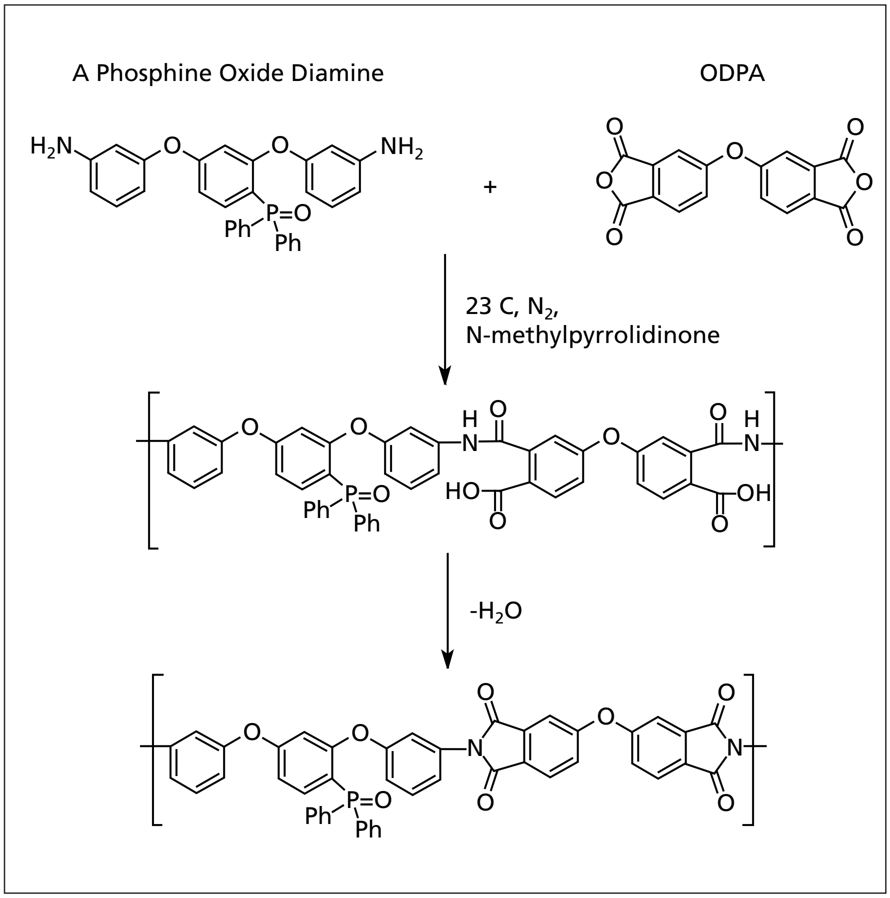
pyrrolidinone (a polar aprotic solvent) at 20 weight percent to form a polyamide acid having an inherent viscosity of 1.01 dL/g. The polyamide acid was converted to the polyimide by reaction with a mixture of acetic anhydride and pyridine. The polyimide was isolated, dried, and dissolved in N,N-dimethylacetamide, then thin films were cast and stage-dried at temperatures up to 250 °C for one hour. A 1.6-mil (≈0.04-mm)-thick film was found to have 85-percent transparency at a wavelength of 500 nm, solar absorptivity of 0.06, thermal emissivity of 0.56, T_g of 212 °C, 5-percent loss of weight upon heating in air at a rate of 2.5 °C/minute up to 461 °C, and the following tensile properties at a temperature of 23 °C: strength of 14.7 kpsi (≈101 MPa), modulus of 410 kpsi (≈2.8 GPa), and elongation of 4.7 percent. A film subjected to atomic oxygen in a ground-based experiment that simulated 6 months in a low orbit around the Earth exhibited 81-percent transmission at 500 nm, only 1.74-percent of mass loss, and excellent retention of properties in general.

In another example, a copolyimide was made from the reaction of ODPA with 75 mole percent of the phosphine oxide diamine and 25 mole percent of 3,4′-oxydianiline. A 1-mil (≈0.025-mm)-thick film of this copolyimide was found to have 88-percent transparency at a wavelength of 500 nm, solar absorptivity of 0.06, thermal emissivity of 0.38, T_g of 218 °C, and the following tensile properties at a temperature of 23 °C: strength of 14.7 kpsi (≈101 MPa), modulus of 460 kpsi (≈3.2 GPa), and elongation of 6.3 percent.



A **Phosphine Oxide Diamine Was Reacted With ODPA** to obtain a polyimide that strongly resists degradation under space conditions.

This work was done by John W. Connell, Joseph G. Smith, Jr., and Paul M. Hergenrother of **Langley Research Center**, *and Kent A. Watson and Craig M. Thompson of the National Institute of Aerospace. The technology is covered in Patent Application No. US 2003/0045670 A1 and NASA Case No. LAR 16176-1 and was exclusively licensed to Triton Systems, Inc. Requests for information on this technology should be directed to Norm Rice at nrice@tritonsys.com.*
LAR-16176-1

Low-Density, Aerogel-Filled Thermal-Insulation Tiles

Lyndon B. Johnson Space Center, Houston, Texas

Aerogel fillings have been investigated in a continuing effort to develop low-density thermal-insulation tiles that, relative to prior such tiles, have greater dimensional stability (especially less shrinkage), equal or lower thermal conductivity, and greater strength and durability. In preparation for laboratory tests of dimensional and thermal stability, prototypes of aerogel-filled versions of recently developed low-density tiles have been fabricated by impregnating such tiles to various depths with aerogel formations ranging in density from 1.5 to 5.6 lb/ft^3 (about 53 to 200 kg/m^3). Results available at the time of reporting the information for this article showed that the thermal-insulation properties of the partially or fully aerogel-impregnated tiles were equivalent or superior to those of the corresponding non-impregnated tiles and that the partially impregnated tiles exhibited minimal (<1.5 percent) shrinkage after multiple exposures at a temperature of 2,300 °F (1,260 °C). Latest developments have shown that tiles containing aerogels at the higher end of the density range are stable after multiple exposures at the said temperature.

This work was done by Maryann Santos, Vann Heng, Alfred Zinn, Andrea Barney, Kris Oka, and Michael Droege of the Boeing Co. for **Johnson Space Center**. *For further information, contact the Johnson Technology Transfer Office at (281) 483-3809.*

Title to this invention has been waived under the provisions of the National Aeronautics and Space Act {42 U.S.C. 2457(f)} to The Boeing Company. Inquiries concerning licenses for its commercial development should be addressed to:

Boeing Company
5301 Bolsa Ave.
Huntington Beach, CA 92657-2099

Refer to MSC-23393, volume and number of this NASA Tech Briefs *issue, and the page number.*