NASA TECH BRIEF

Polyimide Polymers Provide Higher Char Yield for Graphitic Structures

Composite materials consisting of graphite fiber reinforced graphitic matrices (pyrolyzed plastics) are currently being investigated for a wide range of high temperature applications. These composite materials can be used in ablative materials, supersonic aircraft structures, jet engine components, circuit boards, and flexible electrical cable insulation.

Conventionally, the manufacture of these graphite composites requires many processing steps resulting in expensive end products. In an effort to reduce both cost and processing complexity, a technique has been developed that uses new high-char-forming processable polyimide resin systems, to produce the graphitic matrix.

Current processes employ phenolic resin matrix systems which yield about 40 to 60% of graphitic residue on pyrolysis. The operation consists of first preparing a graphite fiber reinforced resin, pyrolyzing it under controlled environment, reimpregnating the charred product with phenolic resin, and finally repyrolysis. The series of steps is repeated in a cyclic fashion and then followed by repetitive graphitic deposition from low molecular weight gases to build up the total graphitic yield to acceptable values (e.g., 99.7%; balance voids). Typically, seven cyclic impregnation and pyrolysis steps are required using phenolic resins to yield a 99.7% graphite product. The many repetitive steps required in this process are time consuming and costly.

The new polyimide resin systems pyrolyze to a product having 75 to 90% graphitic residue, and also evolve a lesser quantity of gaseous by-products. Only three cyclic steps are required using the new resin systems to yield a 99.7% graphite product. Fabrication techniques are standard, but the number of repetitive processing steps is minimized.

Notes:

1. The new polyimide polymers, their properties and other applications, are described in NASA Tech Brief 69-10118.
2. Requests for further information may be directed to:

   Technology Utilization Officer
   NASA-Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B70-10330

Patent status:

No patent action is contemplated by NASA.

Source: E. A. Burns, J. F. Jones, and H. R. Lubowitz of TRW Systems Group under contract to Lewis Research Center (LEW-10860)

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