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Polymer-derived ceramics for space applications

Inorganic and organometallic polymers capable of giving ceramics in good yield (at least 50%) when subjected to pyrolysis are referred to as preceramic polymers. There are several advantages in using preceramic polymers for obtaining ceramics. Using conventional ceramic processing techniques, it is difficult to get non-oxide ceramic coatings, continuous ceramic fibers and ceramic films. Preceramic polymers can be processed using conventional polymer processing techniques into coatings, films, fibers and composites followed by pyrolysis and sintering to get ceramic coatings, ceramic films, ceramic fibers and Ceramic Matrix Composites (CMCs). Unlike the conventional ceramic processing routes, preceramic route invariably gives nanoceramics and hence, it is easy to machine polymer-derived ceramic components. Yet another advantage is that conversion of polymers to ceramics takes place at relatively low temperatures (1200-1500 °C) when compared to conventional processes (~2000 °C). Keeping in view of the potential space applications, the research work on polymer-derived ceramics was initiated in the Space Centre in 1987 and over the years, different types of preceramic polymers such as polycarbosilanes, polysial hydrocarbons, polyborosiloxanes and poly (metalloborosiloxane) have been synthesized and their conversion to ceramics have been studied. These precursors have been evaluated for the following space applications: (1) Oxidation resistant coatings for C/C composites for reentry and reusable launch vehicles, (2) matrix resins for Ceramic Matrix Composites and lightweight ceramics, candidate materials for advanced thermos-structural/thermal protection materials for reusable launch vehicles, (3) thermal barrier coatings, (4) ceramic adhesives and (5) atomic oxygen resistant coatings for low earth orbit space structures.

Biography

S Packirisamy has obtained his PhD from Indian Institute of Technology Kharagpur, India. He initiated the work on polymer-derived ceramics in the Vikram Sarabhai Space Centre, Indian Space Research Organization and continued to contribute in this area until his superannuation as Deputy Director. He was UNESCO Fellow, Tokyo Institute of Technology, Tokyo, Research Associate, Case Western Reserve University, Cleveland and Visiting Scientist, Michigan Molecular Institute, Midland. Presently, he is a Professor of Chemistry at Sharda University, India. He has 14 patents, 45 publications in international journals and 4 book chapters to his credit.

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