Relatively inexpensive, lightweight composite parts could be substitutes for some superalloy parts.

**Aluminum-Alloy-Matrix/Alumina-Reinforcement Composites**

**Marshall Space Flight Center, Alabama**

Isotropic composites of aluminum-alloy matrices reinforced with particulate alumina have been developed as lightweight, high-specific-strength, less-expensive alternatives to nickel-base and ferrous superalloys. These composites feature a specific gravity of about 3.45 g/cm³ and specific strengths of about 200 MPa/(g/cm³). The room-temperature tensile strength is 100 ksi (689 MPa) and stiffness is 30 Msi (206 GPa). At 500 °F (260 °C), these composites have shown 80 percent retention in strength and 95 percent retention in stiffness. These materials also have excellent fatigue tolerance and tribological properties. They can be fabricated in net (or nearly net) sizes and shapes to make housings, pistons, valves, and ducts in turbomachinery, and to make structural components of such diverse systems as diesel engines, automotive brake systems, and power-generation, mining, and oil-drilling equipment. Separately, incorporation of these metal matrix composites within aluminum gravity castings for localized reinforcement has been demonstrated.

A composite part of this type can be fabricated in a pressure infiltration casting process. The process begins with the placement of a mold with alumina particulate preform of net or nearly net size and shape in a crucible in a vacuum furnace. A charge of the alloy is placed in the crucible with the preform. The interior of the furnace is evacuated, then the furnace heaters are turned on to heat the alloy above its liquidus temperature. Next, the interior of the furnace is filled with argon gas at a pressure about 900 psi (≈6.2 MPa) to force the molten alloy to infiltrate the preform. Once infiltrated, the entire contents of the crucible can be allowed to cool in place, and the composite part recovered from the mold.

**Fibrous-Ceramic/Aerogel Composite Insulating Tiles**

**Ames Research Center, Moffett Field, California**

The advantages and disadvantages of fibrous ceramics and aerogels are exploited.

The best features of aerogels and fibrous ceramics are exploited.

Fibrous-ceramic/aerogel composite tiles have been invented to afford combinations of thermal-insulation and mechanical properties superior to those attainable by making tiles of fibrous ceramics alone or aerogels alone. These lightweight tiles can be tailored to a variety of applications that range from insulating cryogenic tanks to protecting spacecraft against re-entry heating.