AIAA 2001-3693
37th AIAA/ASME/SAE/ASEE/ Joint Propulsion Conference
8-11 July 2001
Salt Lake City, Utah

Material Properties of Vacuum Plasma Sprayed Cu-8Cr-4Nb for Liquid Rocket Engines

Robert Hickman[1], Timothy McKechnie[1], Richard Holmes[2]

[1]Plasma Processes Inc.
4914 D Moores Mill Road
Huntsville, Alabama 35811
www.plasmapros.com

[2]NASA Marshall Space Flight Center
George C. Marshall Space Flight Center
Marshall Space Flight Center Alabama 35812

Plasma Processes, Inc. (PPI) has fabricated low cost, high performance combustion chamber liners using innovative Vacuum Plasma Spray (VPS) techniques. Materials for use in the combustion chamber liner require a combination of high temperature strength, creep resistance, and low cycle fatigue resistance along with high thermal conductivity. A new Cu-8Cr-4Nb alloy (called GRCop-84) has been developed at NASA-Glenn as a replacement for the currently used alloy, NARloy-Z. The alloy is strengthened by a fine dispersion of Cr_2Nb particles. The alloy has better mechanical properties than NARloy-Z while retaining most of the thermal conductivity of pure copper. The alloy has been successfully consolidated by extrusion and hot isostatic pressing (HIPing). However, VPS offers several advantages over prior consolidation methods. VPS can produce a near net shape piece with the profile of the liner. In addition, an oxidation resistant and thermal barrier surface can be incorporated as an integral part of the liner hot wall during deposition. Testing shows that VPS Cu-8Cr-4Nb has mechanical properties that match or exceed those of extruded Cu-8Cr-4Nb. This paper compares density, hardness, thermal conductivity, and the elevated temperature tensile and low cycle fatigue properties of Cu-8Cr-4Nb material produced by VPS to material produced by extrusion. The microstructure of the VPS material is also presented.