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Net Shape Fabrication of High Temperature Materials for Rocket Engine Components

Robert R. Hickman, Timothy N. McKechnie, Arvind Agarwal
Plasma Processes, Inc.
Huntsville, Alabama

Vacuum Plasma Spray techniques (VPS) have been developed to reduce the cost and fabrication time of rhenium and refractory metal rocket engine components. Refractory metals and ceramics such as Re, Hf, HfC, W, and W/Re alloys are being used for their high melting temperatures and chemical stability. However, the difficulty of forming these materials into complex shapes has limited their application in the past. The VPS technique involves spraying material onto a mandrel of the desired shape and subsequently removing the mandrel. A primary advantage of VPS forming over other powder metallurgy techniques is that near-net-shape spray forming of components significantly simplifies and reduces the cost of fabrication due to the high material utilization and reduction of laborious machining. Exploitation of these rapid processing techniques will decrease the cost and manufacturing time of fabricating components. VPS Re hot fire test throats have been fabricated and tested. Standard metallurgical techniques have been used to characterize the effect of processing parameters on the microstructure of the spray formed deposits. The deposited rhenium has high density with fine equiaxed grains. Hot fire erosion data will also be presented.