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**Enhanced Near Net-Shape Ceramic Refractory Composite High  
Temperature Cartridge by VPS Metallurgical Alloying Techniques**

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High performance cartridges are being developed by vacuum plasma spray (VPS) forming to near net-shape for use in high temperature space furnaces. A VPS metallurgical alloying technique utilizing alloying elements (rhenium, nickel, etc.) has been developed that produces robust physical properties without jeopardizing the unique chemical properties of the VPS formed tungsten structure. Thin walled cartridges, 0.069 mm (0.027 in.) thick, are produced in continuous lengths of 58.4 cm (23 in.). A refractory metal (i.e., tungsten) is VPS formed as the cartridge wall structure, with a protective ceramic (i.e., alumina) coating inside and out. The ceramic-refractory-ceramic composite provides environmental protection to the refractory metal structure from both chemical attack inside and oxidation outside. The VPS metallurgical alloying process interjected during the spraying operation greatly reduces porosity of the microstructure while enhancing the ductility of the cartridge. Thin walled cartridges have been shown to hermetically seal demonstrating no through porosity. Microstructures have been characterized and material properties will be presented.