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NASA TECH BRIEF

Porous Mandrels Provide Uniform Deformation in Hydrostatic Powder Metallurgy

A program was initiated to investigate the gas-pressure bonding process as a potential means for hot isostatically pressing relatively large, complex beryllium machining blanks from beryllium powder. The powder to be densified was first preformed by cold isostatic pressing to the desired shape. Internal and external cavities were initially formed by use of leachable solid copper mandrels, after which the part was gas-pressure compacted at controlled temperature, and the mandrels selectively removed by leaching.

In two identical specimens pressed in this manner, uneven deformation was observed around the solid copper mandrels. Poor dimensional control and gross cracking were evident, causing failure of the specimen. It was apparent that this method of pressing would not succeed.

Various types of copper powders were then pressureless sintered as a means of producing porous mandrels. On empirical grounds, hydrogen-sintering parameters of 2 hours at 1600°F were chosen as giving greatest promise for producing the desired density. In actual practice, pressureless sintering for 3 hours at 1700°F was found to give densities of 57 to 60 percent of theoretical. The porous copper mandrels were placed in the forming jig and the beryllium powder arranged over and around them. Hot, isostatic pressing formed the blank and the porous mandrels were removed by leaching.

Notes:

1. In contrast to the specimen pressed around the solid mandrels, no cracking occurred in the preform pressed around the porous mandrels.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10209

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

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