May 1967

Brief 67-10124

NASA TECH BRIEF

Silver Plating Ensures Reliable Diffusion Bonding of Dissimilar Metals

The problem:

Joining dissimilar metals by diffusion bonding is often necessary for many applications. The problem of obtaining satisfactory bonds between different combinations of metals arises frequently. A particular objective was to develop an improved method of diffusion bonding 0.053- to 0.081-inch-thick sheets of the following metals: titanium–5 aluminum–2.5 tin to 2219 aluminum; titanium–8 aluminum–1 molybdenum–1 vanadium to 321 stainless steel and to Inconel 600.

The solution:

The surfaces of the workpieces to be joined by diffusion bonding are electroplated with silver.

How it's done:

Surface preparation and electroplating involve the following steps: cleaning with an organic solvent and an alkaline solution; etching in a nitric-hydrofluoric acid solution; anodization in a solution of 7 parts by volume of acetic acid and 1 part by volume of 70 percent hydrofluoric acid, at a current density of 7.5 amperes per square foot; silver striking; silver plating, using a conventional plating bath at room temperature, at a current density of 10 amperes per square foot.

The silver plated surfaces are diffusion bonded at temperatures ranging from 500° to 1600°F and contact pressures from 5500 to 30,000 psi in a vacuum or an argon atmosphere for periods ranging from 10 minutes to 8 hours. Satisfactory bonds were obtained over a wide range of experimental conditions, but a minimum temperature of 1100° to 1300°F was required to ensure proper adherence of the silver plating to the titanium alloys.

Notes:

1. By this method, reliable diffusion bonding of the dissimilar metals is effected at relatively low temperatures, with better control to minimize the formation of detrimental intermetallic phases and to provide a greater tolerance of processing parameters such as cleanliness, time, pressure, and temperature.
2. Copper and tantalum foil may be substituted for the silver plating prescribed for fusion bonding of 321 stainless steel to the titanium alloys.
3. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B67-10124

Patent status:

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

Source: The Boeing Company
under contract to
Marshall Space Flight Center
(M-FS-1975)

Category 03