September 1971

Brief 71-10338

NASA TECH BRIEF

Marshall Space Flight Center

Electroplating on Titanium Alloy

An activation process can form adherent electrodeposits of copper, nickel, and chromium on titanium alloy. Electrodeposition is one of the most common methods of coating titanium with other metals, but it has serious shortcomings. Conventional electroplating can produce a coating on titanium, but there is a distinct lack of adhesion. Studies have indicated that poor adhesion is caused by the formation of an extremely tenacious oxide film after the metal is exposed to the atmosphere. It is mandatory that this film either be removed long enough to permit an initial electrodeposit to be made, or be replaced by some other film that will not limit adhesion. Test specimens were cleaned by vapor degreasing in perchlorethylene and then soaking for 10 to 20 minutes in a proprietary alkali. Good adhesion of electroplated deposits was obtained by using an acetic-hydrofluoric acid anodic activation process.

An alloy composed of titanium, 6% aluminum, and 4% vanadium (Ti-6Al-4V) was tested with chromium, nickel, electroless nickel, and copper. Results indicated that more adherent coatings could be produced with copper. Several copper plating baths were used, including a commercial potassium cyanide copper-plating formulation, an acid copper sulfate bath, and a copper fluoborate bath. Nickel was plated from a Watts-type bath, and chromium from a standard chromic acid sulfate bath.

Plated specimens, 10 cm (4.0 in.) long, 1.3 cm (0.5 in.) wide, 0.16 cm (0.062 in.) thick, were evaluated on the basis of standard qualitative adhesion tests. The specimens were bent repeatedly through an angle of 3.1 rad (180°) until fracture of the basic metal occurred. After fracture, attempts were made to detach the plating from the basic metal with a sharp instrument. In cases of very poor adhesion, the plating separated in large flakes or pulled off easily.

Since titanium alloys are known to be susceptible to damage from hydrogen evolved during metal finishing operations, tests were conducted to detect possible hydrogen embrittlement in treated specimens. The tests included detecting changes in notch-sensitivity at room temperature and at low temperatures on samples subjected to various preplating and plating processes. Some controlled bend tests and chemical analyses were also made to verify the effects of hydrogen.

Note:

Requests for further information may be directed to:

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Reference: B71-10338

Patent status:

No patent action is contemplated by NASA.

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Category 08