January 1967

Brief 67-10006

NASA TECH BRIEF

Complex Surfaces Plated by Thin-Film Deposition in One Operation

The problem:

To develop a method for plating by thin film vapor deposition complex surfaces such as ball bearing assemblies, gears, seals, springs, etc., in one operation, without rotating or moving the object. Present vacuum deposition methods deposit material in a "line of sight," requiring the object to be rotated or moved many times.

The solution:

Deposit the thin film on the object by ion plating. The ionized material to be deposited follows electric lines of force to all points on the object, thus uniformly plating the surface from all sides simultaneously.

How it's done:

A direct-current gas discharge is established between the cathode (object to be plated) and the anode (evaporant source) by admitting an inert gas (e.g., argon) into a previously evacuated system and applying a potential (3 to 5 kv) across the two electrodes. At low pressures (15 to 40 microns), a glow discharge is formed from the ionized inert gas. These positive argon ions (gaseous plasma) are accelerated and bombard the negatively charged cathode. This process, known as sputtering or cathodic bombardment, is used to prepare the surface for metallic deposition. The plating material is then heated and evaporated into the positive glow region of the gas discharge. The evaporated atoms are ionized and accelerated toward the substrate with a high velocity, thus forming a film. Essentially, in ion plating there are two processes, sputtering and ion plating, taking place simultaneously, each of which has a cancelling or competing effect on the other. To obtain a film, the rate of deposition must be higher than the rate of sputtering.

In ion plating, the object to be plated is the termination point for an electric field which exists between the evaporation source and the object. There is a difference of potential between any point on the object and the source. Once the evaporant is ionized in the argon glow discharge, the charged ions follow the electric lines of force to all points on the specimen surface if shielding effects are not present. A strong bond is secured between the film and the substrate since the surface is continuously cleaned (by ion bombardment) before and during the deposition process.

Note:

Inquiries concerning this innovation may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B67-10006

Patent status:

No patent action is contemplated by NASA.

Source: T. Spalvins, D. H. Buckley, and J. S. Przybyszewski
(Lewis-292)

Category 05