

Electropolishing of Titanium

B.Chou, R. Jain, D. McGervey, U. Landau, and G. Welsch

Department of Materials and Engineering, Case Western Reserve University, Cleveland, U.S.

Several techniques can be used to clean and smoothen the titanium substrate surface, namely chemical, mechanical and thermal polishing. Chemical polishing requires HF-containing acid solutions and it does not provide as smooth a surface as the other methods; mechanical polishing can provide a very smooth and flat surface topography, but it is work-intensive and time consuming, furthermore, polishing media can become embedded in the surface. Thermal polishing requires heat-treatment in a high vacuum and specimens must be very clean to start with. Compared to the other polishing processes, electropolishing is an effective method to clean, smoothen and polish, the titanium surface. It removes impurities from the metal surface and gives the surface a high luster.

The present work was carried out to identify effective process parameters for electropolishing titanium. Different voltages, agitation speeds, and polishing times were tried in this work. An electrolyte containing perchloric acid, methanol, and butanol was chosen; 28 volts and 4 minutes were the optimum potential and polishing time. Agitation was found to be a very important factor in this process. The current densities were not uniform around the specimen surface due to the sample sheet shape. The amount of titanium removed during the electropolishing process has been well-analyzed in different ways. The thickness loss on one side was about 10 μm . Vickers indentation helped define the surface topography. The obtained results demonstrate that electropolishing can provide high purity and microscopically smooth titanium substrate.

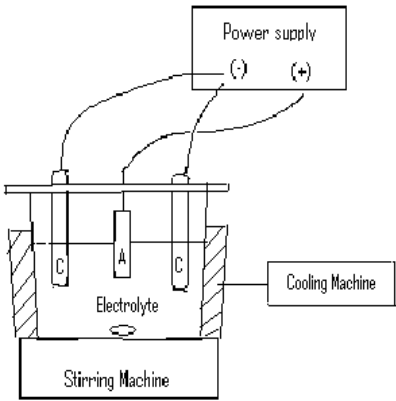


Fig 2. Drawing showing how titanium oxide forms and is removed by spallation or dissolution to leave a polished surface.

(a) (b)
Fig 3. SEM micrograph of the surface roughness of titanium (a) as-received high purity titanium sheet. (b) Electropolished 4min at 28 V and 0.10A/cm², -40°C, electrolyte was stirred at 300 rpm stirring velocity.

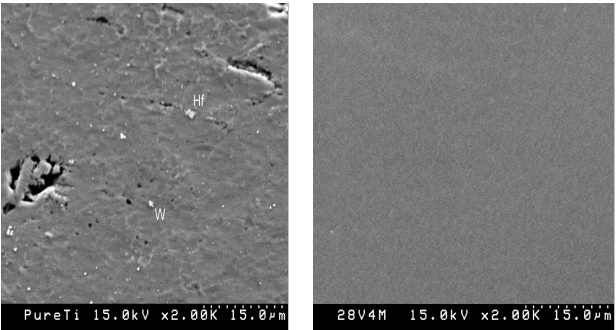


Fig 1. (a) schematic drawing of the electropolishing equipment. A = anode to be electropolished.

