ElectroPolishing Nitinol for Stents and other Medical Devices and Implants Using the FARADAYIC® Process

Objective:

This project is developing the capability of the patented FARADAYIC® Process for electropolishing strongly passive materials, such as Nitinol (Nickel-Titanium alloy), without the use of toxic, highly aggressive chemicals, such as hydrofluoric acid.

Nitinol coupon pattern etched and polished to an Ra < 120 nm.

Summary:

FARADAYIC® ElectroPolishing and Throughmask ElectroEtching processes are under development for the fabrication of Nitinol stents. The Throughmask ElectroEtching technology is being developed to enable rapid stent fabrication while maintaining pattern fidelity in a low-concentration, aqueous electrolyte. This process does not impart thermal damage to the stent, eliminating the need for descaling of undesired oxides, and has etch rates of >25 μm/min for patterns with strut widths of 50 to 100 μm and slot widths of 38 to 400 μm.

A critical process step in conventional stent manufacturing is electropolishing, which is typically done in an electrolyte such as sulfuric/phosphoric acid. Faraday has considerable experience in electropolishing materials in simple, low concentration aqueous electrolytes using pulsed electrolytic fields tuned to the material of interest to achieve the desired surface finish. Data showed electropolishing of Nitinol coupons with a surface roughness's of R_a = 0.12 μm. Due to the low viscosity/high conductivity nature of the electrolyte and the absence of hydrofluoric acid our other chemical additives, the pulse/pulse reverse electropolishing is robust, low cost and safe.

Background:

The patented FARADAYIC® Process is an electrochemical manufacturing technique that utilizes a controlled electric field to polish a metallic work piece. Since the FARADAYIC® Process is electrically mediated, it does not require aggressive chemicals to facilitate the metal removal as needed in conventional chemical processes (e.g. chemical etching). The material removal rate is determined by the applied electric field, which is user-defined and computer controlled. This provides the means for precise control of the length of the process and the total material removed. Additionally, the use of low viscosity acid (e.g. dilute H_2SO_4) or neutral salt solutions (e.g. sodium chloride and sodium nitrate) as the electrolyte makes the process both worker and environmentally safe.

The FARADAYIC® Process technology illustrated above is protected by a substantial patent portfolio including issued, allowed, and pending patent actions.

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