EuroSciCon

August 27-28, 2018
Zurich, Switzerland

8th Edition of International Conference on

Chemistry Education and Research

J Org Inorg Chem 2018, Volume 4
DOI: 10.21767/2472-1123-C5-015

MAGNETOELECTROPOLISHING AND HIGH-VOLTAGE ELECTROPOLISHING OF METALS AND ALLOYS

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Electropolishing of metals and alloys has been developed for many decades now, with its ascents in recently patented magnetoelectropolishing (MEP) process. Most of electropolishing processes proved its usability for a variety of metallic materials, beginning specifically from austenitic stainless steels, through titanium, nickel, cobalt, copper, and their alloys, including many other metals, such as aluminum and its alloys, intermetallic compounds (nitinol), as well as niobium and tantalum. During MEP the stirring is self-imposed by Lorentz force as a result of interaction of electric and magnetic fields. The influence of magnetic field on electrochemical process in MEP can be divided into three main categories: (1) the effect of magnetic field on the mass transfer, (2) effect on kinetics of the electrode reaction, and (3) effects relating to morphology and chemistry of the surface after electrodissolution. The additional external magnetic field applied in the MEP process results in effective modifying the metal surface properties of treated parts in comparison with the properties obtained after a standard electropolishing (EP). During MEP, beneficial modification of oxide layer of treated metals and alloys is obtained. After MEP the protective oxide formed on the surface differs significantly in morphology, homogeneousness, thickness, kind and quantity of foreign species incorporated in it. Concerning the last matter – we found the non-standard conditions of high-voltage electropolishing (HVEP) process (up to 450 V) result in incorporation of some interesting elements from the electrolyte into the surface film. Our studies revealed the copper enrichment of stainless steel, with simultaneous reduction of chromium in the surface layer. Under magnetoelectropolishing of metallic biomaterials, the corrosion resistance, biocompatibility, osseointegration, endothelialization, cleanability, anti-galling and anti-seizing properties are achieved. Some other advantages of MEP are de-hydrogenation of surface layer and a high increase in fatigue resistance, the effects especially valuable in the parts of small diameters or cross-sections.

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