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ELECTROCHEMISTRY IN NANOTECHNOLOGY

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Abstract:

The lecture presents the electrodeposition of iron nickel on copper substrate for high frequency applications, and then presents the pulse plating of the silver coating on Ti6Al4V alloy for biomedical applications.

The interest to pulse electrochemical deposition of nano-structured iron layers is due to their unique soft magnetic properties.

Development of nanostructured soft magnetic materials contributes to miniaturization of magnetic devices. Currently, there is a lack of available methods for the production of soft magnetic metallic materials for high frequency application, above 10 MHz. The mainly iron-based amorphous magnetic ribbons (with a thickness around 20 μm) can be used in the medium radio frequency (RF) range only; this is why the thinner electrochemically deposited layers have got importance in high frequency applications.

Magnetic characterization of the layers with magnetic hysteresis measurements revealed a flat magnetization loop and measurements of permeability vs. frequency showed that these layers can be applied as a flat transformer cores up to 10-60 MHz.

A prototype of planar inductive elements for high frequency application will be shown. The cathode material either is a Cu layer on a polyimide substrate.

Various surgical procedures require the use of implants. Such an implant may be Ti6Al4V alloy which is very strong and relatively light. However the bacterial adhesion and biofilm formation on these alloys can cause various human diseases.

Removing bacteria being in a biofilm is impossible and the local or systemic antibiotic treatment is not effective. In view of increasing bacterial resistance to antibiotics and antiseptics, nanostructured silver coating can be an effective strategy to prevent the bacteria induced infections.

Moreover its antimicrobial activity combined with remarkably low human toxicity. One important fact, which must be taken into account, is that, the silver ions have the antimicrobial effect, not the silver metal. Therefore is very important to develop biocompatible antimicrobial coatings with a controlled Ag^+ ion release rate which should be effective for a long time, and should be low to avoid the toxic effect on body cells, without hindering their excellent biocompatibility. The rate of silver release has been controlled in model solution - in vitro experiments using Electrochemical Impedance spectroscopy method. The (EIS) measurements were performed at open circuit potential.

Local dissolution of the silver coating after exposing the samples to chloride containing solutions as a function of time will be presented on the Conference.