Nanocomposites and nanomaterials

Electrochemical studies of thin films of Cu, Zn, Ni and their alloys as layers in multilayer coatings

A.A. Maizelis, B.I. Bairachniy

Department of Technical Electrochemistry, National Technical University «Kharkiv Polytechnic Institute», Kyrpychova str., 2, Kharkiv-61002, Ukraine. E-mail: a.maizelis@gmail.com.

Among the methods of formation of multilayer coatings consisting of thin (up to 100 nm) layers of metals and alloys, electrochemical method occupies a worthy place, as it is convenient for use in production scale. When forming multilayer coatings, it is necessary to know the elemental and phase composition of individual layers, to exclude contact displacement of positive metal ions from solution by a more negative surface during layer-by-layer deposition, to have an idea of the mechanism of nucleation and growth of crystals of each layer and electrolysis efficiency of all stages.

The answers on these questions were obtained by studying the conditions of Cu, Zn, Ni and Zn-Ni and Ni-Cu alloy films electrodeposition. Since the standard potentials of Cu, Ni, and Zn differ by hundreds of millivolt, we studied kinetics of contact displacement in the systems to obtain firmly coupled layers. We modified the method of Donchenko-Antropov and used it in our study [1]. The compositions of polyligand electrolytes and electrolysis conditions were refined based on the analysis of dependences of contact displacement rate on the surface potential and the time of its immersion in the solution.

The mathematical models and mechanism of crystal nucleation and growth of metals and alloys at multilayer coating deposition were obtained based on analysis of experimental current transients. The elemental and phase composition of alloy films as they were formed and their dependences on the electrolyte composition are determined using and anodic voltammetry.

The publication contains the results of studies conducted by President's of Ukraine grant for competitive projects No. F70/18701 of the State Fund for Fundamental Research and by project of Ministry of Education and Science of Ukraine.

1. *Maizelis A.A., Tul'skii G.G., Bairachnyi V.B., and Trubnikova L.V.* The Effect of Ligands on Contact Exchange in the NdFeB–Cu^{2+}–$P_2O_7^{4-}$–NH_4^+ System // *Russian Journal of Electrochemistry*.-2017.-**53**,N4.-P. 417-423.