SIZE EFFECTS IN ELECTRODEPOSITED NI - COATINGS

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Polycrystalline Ni materials with grain sizes less than 100 nm (nano crystalline NC) and with grain sizes in the micrometer range (micro crystalline MC) in form of thin films have become important in many technologies due to their improved physical, chemical and mechanical properties. Usual the mechanical properties of such coatings are described by a Hardness value and a Young´s modulus measured by Instrumented Indentation Testing (IIT).The behavior of such coatings during indentation test is influenced by different size effects having their representative length scale – grain size, coating thickness, length that characterizes the depth dependence of the hardness (Indentation Size Effect ISE). To estimate realistic values for the intrinsic coating Hardness and Young´s modulus all size effects have to be considered.

For this work thin nano crystalline Ni – coatings (average grain size 30 nm) with thickness from 1 µm to 5 µm were electrodeposited on brass substrates. Indentation tests in the continuous stiffness measurement (CSM) mode were provided on as prepared Ni – coatings using a G200 Nanoindentation system (Fa. Keysight). For estimation of the intrinsic hardness of the coatings from composite hardness values calculated from the measured force –displacement curve using the Oliver & Pharr method, the model described by Z.S. Ma [1] was used.

It was found that the experimental data can be well described by the model. The fitted values for the intrinsic hardness and the fitting parameters will be given. The different values of intrinsic hardness and of length characterizing depth dependence of the hardness for different coating thickness are discussed as results of changes in the coating structure because of changes in deposition parameters.

[1] Z.S. Ma, Y.C. Zhou, S.G. Long, C. Lu: On the intrinsic hardness of a metallic film/substrate system: Indentation size and substrate effects. International Journal of Plasticity 34 (2012) 1-11.

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