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Influence of substrate type on deformation specificity of soft film/hard substrate coated systems under nanomicroindentation

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Abstract

This work is devoted to the study of the effect of a substrate chemical bonding type on the mechanical properties of coated systems (CSs) of a soft film/hard substrate type. The Cu/MgO and Cu/Si coated systems, as well as MgO and Si substrate crystals, which have similar hardness values but different types of chemical bonds, were studied. Various elastoplastic parameters were compared. The general and specific features of the deformation process under nanomicroindentation were identified. It has been established that general properties, such as 'pop-in', 'pop-out', 'elbow' effects, indentation size effect (ISE), are determined by the stress state created in the material during the indenter penetration and depend on the magnitude of the applied load and the film thickness. The specific properties, Young's modulus, hardness, relaxation parameters depend on the crystal structure and elastoplastic properties of the film and substrate material. The difference in the type of chemical bonding of the substrates, despite the close values of hardness, changes the elastoplastic properties and deformation mechanism of the composite structure as a whole, thereby expanding the possibility of creating new materials required for modern technology.

Keywords: *depth-sensing indentation, chemical bond, hardness, elastoplastic properties, deformation mechanism*

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