DSCM 41P **THE PLASTICITY INDEX OF Cu FILMS WITH DIFFERENT THICKNESSES ON HARD SUBSTRATE**

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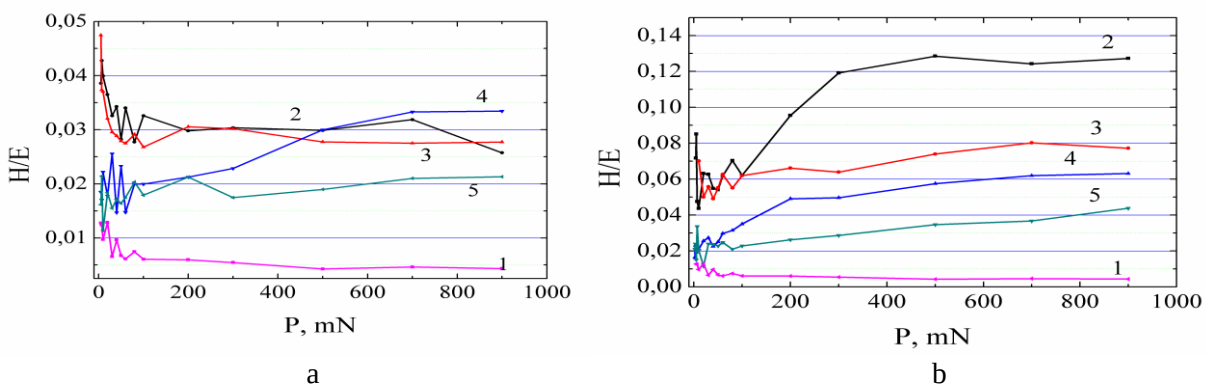
Last years it has been shown that not only the hardness (*H*) and elastic modulus (*E*), but also the plasticity index (*H/E*) is an important parameter that characterizes the mechanical properties of composite structures (CSs). Plasticity index can serve as an indicator of the transition from elastic deformation to plastic one and to destruction [1-3]. In this paper the Cu/MgO and Cu/Si CSs were selected for the investigation of the plasticity index behavior. The nano-microhardness of the MgO and Si single crystals using as a substrate is 10-12 times higher in comparison with the polycrystalline Cu, so the CSs obtained are of type "soft-to-hard". The Cu films with thickness t=85; 470 and 1000 nm were deposited on the MgO and Si substrates by the magnetron sputtering method. Hardness (*H*) and Young' modulus (*E*) were studied by the dynamic indentation method using the Nanotester-PMT3-NI–02 device equipped with a Berkovich indenter in a load range of P_{max}=(5÷900) mN.



a b

Fig. 1. The dependence of the *H/E* plasticity index on the load, *P*, of CSs: a) Cu/MgO and b) Cu/Si: 1– Cu polycrystal; 2 – MgO and Si monocrystals: 3 – Cu/substrate, t_{Cu}-85nm; 4 – Cu/substrate, t_{Cu} – 470nm; 5 – Cu/substrate, t_{Cu} – 1000nm

The lowest values of the *H/E* parameter were revealed on the polycrystalline Cu (curve 1). The *H/E*(*P*) dependences of the Cu/MgO and Cu/Si composite structures demonstrate a more nonmonotonic shape of curves than for Cu. At low loads (5<*P*<100mN), the curves 3-5 (Fig. 1 a and b) suffer an abrupt decrease accompanied by oscillations, then they show a certain increase with following saturation. However, the curves of Cu/MgO and Cu/Si CSs are situated between the Cu (1) and MgO (2) curves (Fig. 1 a, curves 1 and 2) and Cu (1) and Si (2) ones (Fig. 1 b, curves 1 and 2). As follows from the above, composite structures of the "soft-to-hard" type represent new materials with higher values of plasticity index compared with properties of the film and are inferior to the substrate *H/E* values.

[1]. M. Roy. Nanocomposite Films for Wear Resistance Applications. In: *Surface Engineering for Enhanced Performance against Wear*. Springer Vienna, 2013. p. 45-78.
[2]. A. Kavaleiro, D. de Hosson. Nanostructural coatings. Moscow: *Tehnosfera*, 2011, 750 p.
[3]. A. Leyland, A. Matthews. On the Significance of the *H/E* Ration in Wear Control: A Nanocomposite Coating Approach to Optimized Tribological Behavior. *Wear*. 2000, **246**(1-2), p. 1-11