

THE PLASTICITY INDEX OF THE "SOFT-FILM/SOFT-SUBSTRATE" COATED SYSTEMS

Constantin PYRTSAC^{1,2}, Daria GRABCO²

¹Department of Physics, Technical University of Moldova, bd. Stefan cel Mare 168, Chisinau MD-2004, Republic of Moldova

²Institute of Applied Physics, Academy str., 5, Chisinau MD-2028, Republic of Moldova

*Corresponding author: Constantin Pyrtsac, constantin.pirtac@fiz.utm.md

The advanced devices from the last years contain thin films deposited on substrates of materials with different properties, thus forming coated systems (CS) of film/substrate type. Scientists, as well as engineering staff are increasingly interested in knowing the mechanical properties of CS used in micro- and nanoelectromechanical systems [1].

In this paper, we investigate CS of the type „soft-film/soft-substrate” – *Cu/LiF* with different thickness of films: nanometric ($t_1=85$ nm), submicronic ($t_2=470$ nm) and micrometric ($t_3=1000$ nm), obtained by the magnetron sputtering method. The mechanical properties of the CS mentioned above were investigated by using the nanoindentation (NI) tester equipped with a trihedral diamond Berkovich pyramid as an indenter [2]. Along the hardness (H) and Young's module (E), the mechanical properties of CS are also characterized by the H/E ratio called "plasticity index" [3]. We show that for the studied materials, the values of H and H/E change with the P_{max} load increase. We show these dependences in Fig. 1.

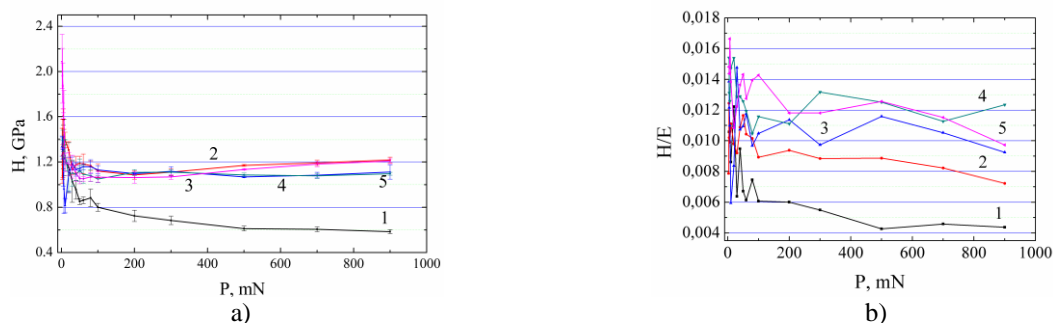


Fig. 1. Dependencies reflecting the variations of the hardness (H) a) and plasticity index H/E b) of the load P_{max} value in the range (5 ± 900) mN at NI tester for all CS *Cu/LiF* and monolithic crystals. The respective curves are characterized by: 1 – the polycrystal *Cu*, 2 – the single crystals *LiF*, 3 – *Cu/LiF*, $t_1=85$ nm, 4 – *Cu/LiF*, $t_2=470$ nm, 5 – *Cu/LiF*, $t_3=1000$ nm.

From Fig. 1a) one can see that the $H(P)$ CS dependences have the form similar to the hardness $H(P)$ of the *LiF* substrate, however, they have higher values compared to the polycrystalline *Cu*.

The values of the plasticity index, H/E , of the CS (Fig. 1b) demonstrate the higher values compared with materials used for the creation of these structures that indicates their higher resistance to plastic deformation.

Keywords: coated systems, nanoindentation. mechanical properties, plasticity index.

References

1. A. S. H., Makhlof, I. Tiginyanu. Nanocoatings and ultra-thin films: Technologies and applications. Cambridge: Woodhead Publishing Limited, 2011. 428 p.
2. W. C. Oliver and G. M. Pharr. An improved technique for determining hardness and elastic modulus using load and displacement sensing indentation experiments. *J. Mater. Res.*, 1992, Vol. 7, No. 6, p. 1564-1583.
3. A., Leyland and A. Matthews. On the Significance of The H/E Ratio in Wear Control: A Nanocomposite Coating Approach to Optimized Tribological Behavior. *Wear.*, 2000, 246(1-2), p. 1-11.