NNN 22 P **HARDNESS OF Cu/LiF COMPOSITE STRUCTURE UNDER DYNAMICAL INDENTATION**

C. Pyrtsac

Institute of Applied Physics, Moldavian Academy of Sciences, 5 Academy str., Chisinau, Moldova
E-mail: pirtac@phys.asm.md

A permanent growth of the integration level and packaging density of chips on the crystals requires the sufficient increase of reliability and enhancement of the material servicing characteristics. At present, as a rule, aluminium and Al-Cu alloys are used as basic material for the interconnections. As a potential substitute for Al, it can be considered copper, which possesses higher properties: thermal capacity, thermal conductivity, electroconductivity and considerable resistance to the electromigration. It is known, servicing characteristics of thin metallic films are generally determined by electrical properties. At the same time, mechanical properties determine the service life period of product, therefore it is necessary to make the durable and reliable goods [1].

Last years, the nanoindentation is very large used to study mechanical properties of thin-film materials. This method allows studying the processes of both the elastic and plastic deformations in very small volumes. In present work, the Cu/LiF composite structure (CS) was selected for the investigation taking into account that its components have many common properties: belonging to the same cubic crystalline structure, the approximate values of microhardness (H_V≈1,0 GPa for Cu and H_V≈1,1 GPa for LiF), sufficiently high plastic properties. Cu films with thickness *t*=500 nm were deposited on the LiF single crystalline substrates by the magnetron sputtering method. Nanoindentation was carried out with Nanotester-PMT-3-NI-02 using the dynamical regime of penetration. The loads on the Berkovich indenter varied in the limits P_{max}=2÷900 mN. Hardness (H) and Young' modulus (E) were calculated using the Oliver-Pharr method [2] by means of software for each separate indentation.

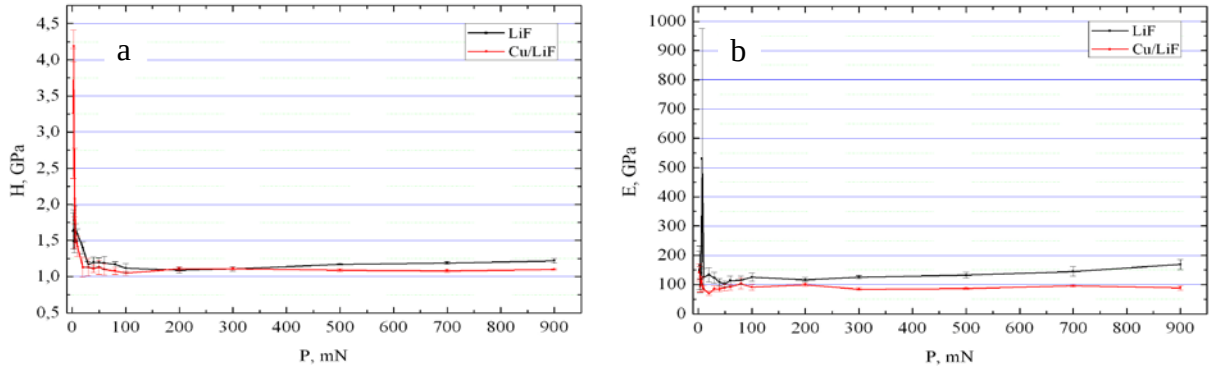

Fig.1. Relations H(P) (a) and E(P) (b) for the composite structure Cu/LiF and for the LiF substrate

The obtained results revealed that Cu/LiF CS hardness was closed to the H value of LiF substrate or at 10-15% less in the load interval 10÷900 mN (Fig. 1 a). At the load diminution from 10 to 2 mN the hardness sharply increased and at P_{max}=2 mN reached the value of 4.8 GPa exceeding the substrate hardness value two and a half times as much (Fig. 1 a). Such a result, thinking, is produced by the well known indentation size effect (ISE). As regard the Young' modulus for the Cu/LiF CS, its value is at the 15-20% less than for the LiF substrate in the whole interval of the applied loads (2÷900 mN) (Fig. 1 b). This fact indicates the higher plasticity of the Cu film as compared with LiF substrate.

[1]. А. В. Панин и др. *Физическая мезомеханика,* 2003, **6,** 2, с. 91-98
[2]. W. C. Oliver, G. M. Pharr. *J. Mater. Res.*, 1992, **7,** 6, p. 1564-1583