Nanoindentation Study of Boron-Ion Implanted Polymethylmethacrylate with Ultra Nano Hardness Tester: Methodological Aspects

Kavetskyy T.S.[1,2], Kukhazh Y.Y.[1], Borc J.[3], Stepanov A.L.[4,5,6]

[1]*Drohobych Ivan Franko State Pedagogical University, Drohobych, Ukraine*
[2]*The John Paul II Catholic University of Lublin, Lublin, Poland*
[3]*Lublin University of Technology, Lublin, Poland*
[4]*Kazan Physical-Technical Institute, Russian Academy of Sciences, Kazan, Russia*
[5]*Kazan National Research Technological University, Kazan, Russia*
[6]*Kazan Federal University, Kazan, Russia*

Depth-sensing indentation, called as nanoindentation, means an instrument which possesses the ability to measure the indenter penetration depth h under an applied force F throughout the testing cycle [1]. This method gives information about the contact parameters and mechanical properties, which are calculated from the indenter load and the depth measured continuously during loading and unloading. The advantages are very low loads and only minor depths with no special demands on the test specimens. It is capable of measuring both the plastic and elastic deformation of the material under test. The method was originally developed for testing the hardness and elastic modulus from indentation load-displacement data in elastic-plastic materials including fused silica, soda-lime glasses, and single crystals of aluminum, tungsten, quartz, and sapphire [2] and further reviewed with advances in understanding of the mechanics of elastic-plastic indentation [3].

Recently, we have reported [4] a first time the results of investigation of the influence of low dose B^+-ion-irradiation on the mechanical properties (hardness and elastic modulus) of polymethylmethacrylate (PMMA) probed by nanoindentation with an ultra nano hardness tester (UNHT) in the range of 300-1100 nm indentation depth. The current work is focused on the nanoindentation study of the B:PMMA samples with the UNHT up to 2000 nm indentation depth, governing three expected layers: (i) "implanted layer" up to 500 nm, (ii) "implanted layer + matrix" up to 1100 nm, and (iii) "implanted layer + matrix" with deeper penetration of indenter into matrix. The methodological aspects of progressive multicycle used for the nanoindentation tests are presented.

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4. T.S. Kavetskyy, J. Borc, Y.Y. Kukhazh, A.L. Stepanov, In book: NATO Science for Peace and Security Series - A: Chemistry and Biology, Chapter 7 "Nanoscience Advances in CBRN Agents Detection, Information and Energy Security" (P. Petkov, D. Tsiulyanu, C. Popov, W. Kulisch, eds.), Berlin: Springer, 2015, P. 65-71.