

Nanoobjects microscopy and Nanostructured Surfaces

Proton beam writing for nanofabrication: First achievements of Sumy nuclear microprobe

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Proton beam writing (PBW) is a direct writing technique for micro- and nanostructures fabrication in resist materials by means of an ion beam of low and medium energies [1]. The main equipment for PBW realization is a nuclear microprobe [2]. Usually it uses a collimation system and quadruplet magnetic lenses for focusing ion beam into a spot on the target. Besides, the focused beam can scan over the target surface.

The PBW technique relies on the fact that the ion beam irradiation causes a change of physicochemical properties of the resist material. The predetermined pattern of irradiated sample is then removed by chemically treatment, leaving precise 3D microstructure. The copies of this structure can be produced then in metal using electroplating.

Application of the PBW at microprobe facilities is widespread nowadays. The main advantages of focused ion beams – deep and straight proton track into the resist material, a short range of the secondary electrons – enable PBW to fabricate 3D, high aspect ratio structures with smooth sidewalls.

PWB technique implementation was started at nuclear microprobe facility at Institute of Applied Physics (IAP), National Academy of Sciences of Ukraine. The exposure experiments were carried out using 1 MeV protons and polymethylmethacrylate (PMMA) as a resist material. The result structures were analysed by electron microscopy.

This work describes the main stages of PBW technique based on recent achievements in the world. The results of the first PBW experiments implemented by IAP microprobe are also presented.

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2. J. A. van Kan, P. Malar, and Armin Baysic de Vera The second generation Singapore high resolution proton beam writing facility // Review of Scientific Instrumnets – 2012. – Vol. 83, Issue 2, – P. 02B902-02B902-3.