

Microstructures Created by Proton Beam Writing on the Surface of Chitosan Films Modified with Metal and Metal Oxides Nanolayers



<u>Kalinkevich O.V.</u>, Polozhii H.Ye., Kolinko S.V., Zinchenko Ye.I., Kalinkevich A.N., Karpenko A.Yu., Baturin V.A., Danilchenko S.N., Ponomarev A.G. *Institute of Applied Physics, NAS of Ukraine*

oksana.kalinkevich@gmail.com

Proton lithography or proton beam writing (PBW) is a method of creating highresolution three-dimensional nano- and microstructures by treating a substrate (resist) with a focused proton beam with energy of several MeV. With this technology, it is possible to create complex structures in polymers with high precision and reproducibility. Since the trajectories of high-energy protons in polymers are almost linear, the quality and smoothness of the walls of the resulting structures are very high. **Today**, the main polymer used as a resist in PBW is the synthetic polymer polymethylmethacrylate (PMMA). **However**, the application of the PBW for the creation of three-dimensional micro- and nanostructures on the surface of other



Comparison between (a) p-beam writing,

(b) FIB, and (c) e-beam writing [1].

polymers, especially of biological origin looks very promising. This is important, for example, for the creation of **biocompatible sensor microchips** and **"green" electronics** capable of biodegradation without or with minimal environmental pollution.



Chitosan is one of the most popular polymers of biological origin, widely used in biomedicine, food industry and many other fields of application. In our work, microstructures of a given design were obtained for the first time on the surface of films made of pure chitosan, as well as chitosan, on the surface of which nanoscale coatings of titanium, zinc, molybdenum and their oxides were applied by magnetron sputtering. Pilot experiments were successful and showed that using the PBW method it is possible to obtain **microstructures** of a complex design **on the surface of chitosan** biopolymer with **good resolution and walls quality**.



Linear structures on the surface of pure chitosan film

Structures on the surface of a chitosan film with a nanolayer of zinc oxide

References

[1] F. Watt, M.B.H. Breese, A.A. Bettiol, J.A. van Kan Proton beam writing // Materials Today. – 2007. – v. 10(6). – P. 20-29. https://doi.org/10.1016/S1369-7021(07)70129-3

