DOI: 10.34854/ICPAF.51.2024.1.1.109

ANALYSIS OF ISSUES RELATED TO LOW-DENSITY LAYERS OF METAL NANOPARTICLES, INCLUDING CHITOSAN *)

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A number of issues and proposals for the development of the direct and indirect laser targets for ICF and methods for their prepare and monitoring are analyzed. Interest in such work is determined by the importance of such target design for modern laser installations. The use of targets with additional layers of metal nanoparticles makes it possible to solve f significant number of ICF such as: the increasing the conversion of laser radiation into x-rays, increasing the neutron yield and compression stability, as well as diagnostic purposes. These layers are also used as structural layers in targets [1,2]. The problem of manufacturing and measuring low-density nanometallic layers with a density several times and even orders of magnitude less than the density of solid materials of the same compression has become necessary. This also includes thermal strengthening of layers of metal nanoparticles for more comfort transportation and for working in a chamber for interaction with laser radiation.

Chitosan, which is natural material, was used in the form of polymer matrix to obtain low-density materials containing Ag nanoparticles, content metal 8-20 wt%. Ag nanoparticles were obtained by chemical precipitate and introduced into chitosan solution in the form of a dispersion. In this case the solution to obtain a composite hydrogel was cross-linked with dialdehyde; it was possible to solve the problems associated with sublimation drying of cryohydrogels of cross-linked chitosan [3].

For the correct interpretation of experimental results, comprehensive precision monitoring of such layers has been developed, since accuracy of control of such layers in target directly affects the final results of the ICF research. To control thin layers with metal dispersions, including chitosan, the method of x-ray tomography of samples was used [4]. Calibration methods for monitoring density and thickness, as a wall as target density fluctuations, have been developed using electron microscopy, conventional optical and laser radiation and microradiography in a wide range of x-ray radiation.

References

[1]. A.S.Orechov., A.A. Akunets.,L.A.Borisenko., N.G.Borisenko.,A.I.Gromov.,Yu.A. Merkuliev.,V.G. Pimenov., E.E. Sheveleva.,V.G.Vasiliev. Modern trends in low-density materials for fusion./ Journal of physics: Conference Series, 2016, 688(1),012080.

[2]. Chanprint Kaur, S. Chaurasia, N.G. Borisenko, A.I. Gromov, A.A. Akunets, G.V.Sklizkov, G.A. Vergunova and S.Y. Gus'kov. Demonstration of gold plasma as bright x-ray source and slow ion emitters./ Plasma Physics and Controlled Fusion, 2019, V.61, N8, 084001.

[3]. Y.F. Azarova., A.V. Pestov.,S.Y. Bratskaya. Application of chitosan and its derivatives for solid-phase extraction of metal and metalloid ions./ Cellulose, 2016, 23(4), p.2273.

[4]. N.G. Borisenko., I.A. Artykov., A.A. Eriskin,.A. Akunets., A.I. Gromov., И.Р. Kuvshinov., A.V. Pastuhov. The experience of microtomography of nanostructured objectc.7p.Collection of reports of the 6th Russian Scientific Conference" Practical of tomography". Moscow. September 26-27. 2023.

*) abstracts of this report in Russian