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EVOLUTION OF LOW-DENSITY LAYERS OF METAL NANOPARTICLES FOR ICF *)

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Research and development of technologies for obtaining low-density layers from nano-particles of various metals have been carried out in the Neutron Physics Department LPI for more than a quarter of a century [1]. There are a significant number of tasks that use similar layers. Among them: more efficient conversion of laser radiation into X-ray radiation, increased neutron yield and for diagnostic purposes [2,3]. Free-standing layers of these substances are also needed for solving practical problems in the study of laser plasma, such as: optimizing absorption, creating conditions for plasma stabilization, and a number of others.

Layers of individual metal nano-particles form chains and represent a kind of “metal snow”, so we note the complexity of ongoing developments and research, both often conducted in a limited amount, and due to the micro-quantities of substances used. The works was carried out both under an optical microscope and using scanning electron microscopy to characterize the parameters of the layers [4]. Layers of nano-particles were obtained by evaporation of the substance at (1-3) mm Hg of an inert gas, followed by prolonged deposition ~ 48 hours. Thermal strengthening was also used.

Initial studies were carried out with Cu, and it was possible to obtain densities of 1/50-1/70 of the density of solid copper, i.e. ~ 130-180 mg /cm^3, but since the layers of copper nano-particles are pyrophoric, the following studies were carried out with Sn. With this metal, a density of about 40 mg/cm^3 and individual particle sizes of 10-25 nm were obtained.

Further developments were carried out with Bi, as with a material close to Au in a number of parameters. At the same time, it was necessary to change the technology and design of evaporators. On a layer of Au nano-particles, we have the lowest relative density of 1/300 of of the density of solid Au, or ~ 60 mg /cm^3 , and nano-particle sizes of 5-10 nm. At Ag ~80 mg /cm$^{3.}$

Considerable attention was paid to monitoring issues, since the accuracy in measuring such layers directly affects the results of the experiment [5,6].

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