HIGH TEMPERATURE PROCESSES IN TECHNOLOGY POLYMER CAPSULES FOR THERMONUCLEAR TARGETS [[1]](#footnote-1)\*)

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The report is devoted to the analysis of high-temperature processes of formation of hollow polymer microspheres with ideal geometric parameters for the needs of laser thermonuclear fusion and other alternative applications. The shells are obtained by the method of high-temperature foaming of solid spherical granules containing a blowing agent at temperatures above the depolymerization temperature $T\_{dp}$ the polymer [1].

Calculations carried out for the model "heat-conducting heating - foaming" show that to obtain capsules with a diameter of ≥ 3 mm. fall furnaces with a heating zone height of several meters are required [2]. However, in a physical experiment, we obtained polystyrene shells with a diameter of ≥ 3 mm. at temperatures $T\_{f} \geq 2.5T\_{dp}$ at a heating zone height of 0.5 m. In a model experiment, when foaming porous granules obtained from continuous initial granules similar to the initial granules of the physical experiment and saturated with a gas generator, capsules of similar sizes were also obtained. These results show that at temperatures $T\_{f} \geq 2.5T\_{dp}$, heat and mass transfer makes a significant contribution to the heating process, and alternative mechanisms are realized in the process of foaming [3].

High temperatures initiate or accelerate physical and physical-technological processes. The high temperature and heating rate of solid polymer granules includes the mechanisms of granule spherization and elimination of defects and i heterogeneities, which are either a product of the initial defectiveness of the granule structure, and/or arise during a technological process failure. In this case, high temperatures and high heating rates create deep levels of supersaturation and a high frequency of the formation of gas phase nuclei, i.e. stimulate homogeneous nucleation and subsequent spherically symmetric foaming. Large temperature gradients in spherically symmetric foam structures initiate the transfer of the gas phase to the center of the granule, heat and mass transfer, which prevail over other mechanisms of heat transfer, accelerate the heating of the center of the granule, the processes of structuring and degradation of foam, the formation and expansion of a hollow microcapsule.

High-temperature foaming in combination with the use of heat-exchange gases with high thermal conductivity and viscosity, with the use of low pressure in the chamber and the use of an extended anti-stress transition from the heating chamber to the cooling chamber in the device, guarantees the formation of hollow microspheres with characteristics that meet the requirements for targets for laser thermonuclear fusion.

References

1. A.A. Akunets, V.M. Dorogotovtsev, Yu.A. Merkuliev and all, Production of hollow microspheres from solid plastic granules, Fusion technology, v. 28, No 5, pp. 1781 (1995).
2. Y.A. Merkuliev, S.A Startsev and R.C. Cook, Simulation of high temperature formation of large (2 mm) polystyrene shells from solid granules, Book of viewgraphs for the Eleventh Target Fabrication Specialists' Meeting, Orcas Island, Washington, Sept. 8-12, (1996).
3. V.M. Dorogotovtsev,Mechanisms of forming hollow microspheres from solid granules, Journal of Russian Laser Research, Volume 40, Number 2, March, (2019).
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/It/ru/DN-Dorogotovtsev.docx) [↑](#footnote-ref-1)