Specific Features of the Spheroplastic Based on BUTADIENE-NITRILE RUBBER Destruction under a high-current electron beam impact [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2021.48.1.144

1,2,3Kazakov E.D., 1Kalinin Yu.G., 1Krutikov D.I., 1Kurilo A.A., 4Milekhin Yu.M., 1Orlov M.Yu., 4Sadovnichii D.N., 1Strizshakov M.G., 4Sheremetyec K.Yu.

1NRC "Kurchatov Institute", Moscow, Russia, [Kazakov\_ED@nrcki.ru](mailto:Kazakov_ED@nrcki.ru)  
2FCDT “Soyuz”, Dzerginskij, Moscow Region, Russia  
3NRU MPEI, Moscow, Russia  
4MIPT, Dolgoprudny, Moscow RegionRussia

Recent experiments [1] have shown that the impact of the Calamary high-current electron accelerator on the spheroplastic is accompanied by intensive ablation of the latter's surface and the formation of nanowhiskers on destroyed microspheres. The electron beam provides energy release levels sufficient for evaporation of the target material and generation of shock-wave processes [2, 3]. Note that the experimental conditions [1] strongly differ from the classical conditions for the preparation of filamentary nanostructures [4, 5].

One of the possible mechanisms for the formation of nanowhiskers in spheroplastics under the action of electron beam on it is associated with the formation of filamentous structures from condensed products of pyrolysis of the polymer base in the volume of the collapsing microsphere [1]. Therefore, it is of interest to study the effect of a high-current electron beam on a spheroplastic, the polymer base of which does not contain silicon atoms.

In this work, we have experimentally studied the features of the impact of the Calamary accelerator beam on a spheroplastic, in which the low-molecular-weight nitrile butadiene rubber SKN-10KTR, reinforced with heat-resistant asbestos fiber (8 wt.%), was used as a polymer base, and MC-A9 glass microspheres had a diameter 30-130 microns. The mass fraction of glass spheres was 28%. The density of the spheroplastic is 820 kg/m3.

It was found that at a beam energy flux density of 170–210 J/cm2, the velocity of plasma expansion from the surface of the irradiated sample reaches 25 km/s, and the ablation products contain micron-sized fragments of glass spheres. The experiments have shown that the chemical nature of the polymer base of spheroplastics has a decisive effect not only on the features of ablation under the nanosecond action of relativistic electrons, but also on the possibility of the formation of filamentary structures during the collapse of glass spheres.

Experiments on the Calamary facility were carried out with the support of the NRC “Kurchatov Institute” (Order No. 2073 of 09.10.2020).

References

1. Milekhin Yu.M., Sadovnichy D.N., Sheremetyev K.Yu., Kalinin Yu.G., Kazakov E.D., Markov M.B. // Reports of the Academy of Sciences. 2019.Vol. 487. N 2.P. 159–163.
2. Demidov B.A., Ivkin M.B., Petrov V.A., Fanchenko S.D. // Atomic Energy. 1979.Vol. 46. V. 2.P. 101–116.
3. Ananiev S.S., Bagdasarov G.A., Gasilov V.A., Danko S.A., Demidov B.A., Kazakov E.D., Kalinin Yu.G., Kurilo A.A., Olkhovskaya O .G., Strizhakov M.G., Tkachenko S.I. // Plasma Physics. 2017.Vol. 43. N 7.P. 608 - 615. DOI: 10.7868 / S0367292117070022
4. Tretyakov Yu.D., Gudilin E.A. // Advances in chemistry. 2009.Vol. 78.N. 9.P. 867–887.
5. Dubrovsky V.G., Tsyrlin G.E., Ustinov V.M. // FTP. Vol. 43. V. 12, pp. 1586–1628.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVIII/Pt/ru/GN-Kazakov.docx) [↑](#footnote-ref-1)