Nano-sized diamond will improve materials for maritime transport

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Nikolai Kakhidze, a Master's student at the Faculty of Physics and Engineering, who just has returned from internship at the Brunel University

An experiment on the introduction of nanoscale diamond into an aluminum melt using ultrasonic treatment at the Brunel University (London, United Kingdom) has been completed. The result will be used to create new materials, mainly for maritime transport. The experiment was conducted at the Brunel Center for Advanced Solidification Technology (BCAST) under the guidance of Dmitry Eskin, Professor at TSU and Brunel University London.

No one had previously synthesized alloys with nanodiamonds; for this, larger particles or graphite were used. Scientists at TSU view diamond as a promising material for the production of hardened alloys, although other nanoparticles are also used.

The resulting materials can be used in the aircraft, automotive, and space industries for the manufacture of shells, interior decoration, and other elements not related to the actuators (engines, gearboxes). They will reduce the weight and improve vehicle safety parameters.

"The experiment on the introduction and distribution of nanoparticles in aluminum alloy was carried out in order to understand how to increase the mechanical characteristics of the alloy during technological processing (ductility, weldability, and others) and operation (corrosion resistance), while maintaining the quality," says Nikolai Kakhidze, a Master's student at the Faculty of Physics and Engineering, who just has returned from internship at the Brunel University. "For the introduction of nanoparticles into the aluminum alloy, we used special ligatures with nanoscale diamond, which were obtained by the original method of shock-wave compaction patented by TSU (RF Patent No. 2654225)."

Nanoscale diamond is a powder of diamonds, with a particle size of several nanometers. Master alloys are auxiliary alloys used to introduce other elements into the liquid metal. In this experiment, they are rods that will later be quite convenient and technologically advanced for use

in production.

The experiment showed that the resulting alloy is of high quality, without pores and defects. Thus, the parameters chosen by scientists made it possible to introduce nanoparticles into the alloy without degrading the quality of the starting material; this will further contribute to a significant increase in mechanical properties.

The production of new light alloys based on aluminum with enhanced characteristics is an urgent task for materials science. The introduction of even a small amount of nanoparticles (less than 1%) can lead to a significant increase in the physical and mechanical properties of inexpensive aluminum alloys. Such compounds will have a lower cost compared to the analogs currently used, where the expensive scandium is used for ligatures.

The study was conducted in the TSU High-Energy and Special Materials Research Laboratory as a part of the project related to the production of materials for marine shipbuilding.

BCAST is a division of the Brunel University London. It is engaged in innovative research in crystallization control technology, the development of methods for processing liquid metal. They also conduct their own applied research with individual industrial partners.

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