a liquid phase both in space and on Earth, as well as predicting their results.

To conduct this experiment, it is intended to develop a compact device equipped with a photosystem for photographing the drop profile on photographic film. The working chamber of the device is titanium or steel box (3—5 litre volume). Two optical windows of about 50 mm diameter are mounted in two opposite walls of the box. A manometer for gas pressure measurement and a valve for inert gas supply are fastened on the chamber cover. The table and the studied substance supply system consisting of a syringe feeding liquid onto the substrate surface will be installed inside the chamber.

The second objective would be to obtain experimental data on the following issues:

— behavior of metal melts in broad (6 — 10 mm; non-capillary for Earth conditions) high (50 mm and more) gaps between metal and glass or ceramics;

— crystallization of these melts in the indicated gaps under microgravity;

— standard brazed samples as such [3].

The obtained data will be very important for further study and development of the surface phenomena theory. They will provide both an understanding of the physical-chemical processes occurring under the mentioned conditions and modifying the present technologies for non-metals/metals brazing. It is impossible to carry out similar experiments on Earth because of the metal melt flowing out of a broad gap. The role of gravity in the described processes can be investigated only under the conditions of long-term weightlessness.

It is intended to conduct this study in a small-sized periodic-action vacuum device located at the ISS either inside the URM or in the ISS lock chamber. The equipment includes a small-sized vacuum pump of turbomolecular, getter-ion or magnet-charge type, a vacuum chamber with the heater and viewing window, and the control panel.

The essence of the experiment consists in measuring the contact angles of wetting of solids by liquid solders under microgravity during an orbital flight and in studying the conditions of liquid solder containment in a broad brazing gap. It is planned to measure the contact angles of liquid metals (low melting alloys based on Sn, In, Pb, etc.) on non-metal substrates (quartz) in the high vacuum under microgravity. The contact angle measurements will be performed using the same systems both on the Earth and onboard the space vehicle. The results of ground- and space-based experiments will be compared.

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«Technology» Experiment

NEW CAPABILITIES OF GROWING SEMI-CONDUCTOR MATERIALS BY THE METHOD OF ELECTRON BEAM CRUCIBLELESS ZONE MELTING UNDER MICROGRAVITY

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Improvement of the quality of semi-conductor materials is one of the priority tasks for all the industrialised countries. An essential obstacle in this path is the presence of the gravitational field of

Earth. There are well-grounded reasons to believe that the materials, which will be produced using perfect technology under microgravity (MG), will be characterised by parameters close to the theoretically anticipated ones.

A promising method for production of semi-conductors in space is the crucibleless zone melting (CZM) with a disc-shaped electron beam, which is based on the extremely clean conditions of the molten zone formation.

The principle of operation of such a unit and its main operational parameters are presented in detail by the authors in [1]. The principally important advantages which are characteristic of the electron beam method of CZM (compared to other methods), are described in detail in [2]. It should be noted that our main attention was recently focused on the search for and practical implementation of the modes of conducting CZM, which provide the formation of the solidification front quite close to the plane one in its shape. This is exactly that is indicated by the data in [3]. Considering that the plane solidification front whose provision is one of the most important and necessary conditions of formation of perfect and homogeneous crystals turned out to be quite achievable with the above method, we can see good prospects for its use under MG for production of perfect semi-conductor materials.

A characteristic feature of the molten zone under the conditions of electron beam CZM is the high effectiveness of the solidification front ousting the donor type additives (phosphorus) typical for n-Si. In Si crystals it is characterised by a segregation coefficient which essentially differs from a unity [3].

The influence of rotation of the ingot being grown relative to the melt on the shape of the solidification front and other characteristics of the crystals, was studied at different times and by different researchers under the conditions of terrestrial experiments using CZM with resistance heating. However, under the conditions of $1g_0$ no essential influence on the solidification results was found. It is probable that at $1g_0$ the regular hydrodynamic convection is too effective, compared to the melt mixing as a result of the ingot rotation.

Investigations performed by the authors on the influence of the ingot rotation on the degree of cleaning in electron beam CZM showed that in this case there is a tendency of improvement of the degree of cleaning.

Under MG during zone melting by the electron beam, the melt mixing in the zone will be practically due only to Marangoni convection.

Therefore, the melt mixing in the zone as a result of the sample rotation can prove to be competitive against Marangoni convection or even superior to it in its importance. However, only comparative studies can provide an unambiguous answer to this question, which should to be conducted at $1g_0$ and at MG.

We are also working to acquire the ability to effectively use the increase in the molten zone height under MG, to provide its additional cleaning from additives under the action of an electric field superposed on the crystal in its growth direction.

The electric current which is generated by this field, enables a purposeful change (i. e. regulation and stabilization) of the thermal mode directly on the solid-liquid interphase due to Peltier effect developing on this interphase at current passage along the crystal during its recrystallisation. All this will create the required technological support for investigation of a number of fundamental issues of the physics of solidification and phase transformations under MG, which cannot be performed at all on Earth.

The research data obtained in this experiment will allow optimisation of the processes of heat and mass transfer and of the directly related to them technologies of semi-conductors melting on Earth.

The E. O. Paton Electric Welding Institute is currently making a flight unit for conducting the electron beam CZM under microgravity onboard the URM of the ISS. It is planned to perform in this unit the above-mentioned and other research related to space materials science.

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