

ties of each alloying element affect the structure of the composites. The decrease in the gravity level should change the macro- and microstructure of composites.

Production of DS eutectic alloys by zone melting has some difficulties under the ground conditions. On the one hand, a liquid zone is overheated by the electron beam that is necessary to obtain high temperature gradients, and at the same time it is limited by the flowing quality of the melt. On the other hand, the overheating of a melt generates the thermoconvection process, which upsets the planar front stability and causes an increase of the number of structural defects. DS under microgravity will enable stabilisation of the influence of these factors for creation of a perfect eutectic structure.

The experiment will be carried out in two stages. At the first stage, a series of technological DS experiments with the Ni-Nb-C alloys will be performed under microgravity. They are intended to study the composite growth field of alloys in the direction of the increase of the strengthening phase content. At this stage, a great number of sub-experiments will be conducted with various solidification velocities to establish the maximum velocity during

the existence of the planar front. At the second stage, DS experiments with complex alloying (6—10 alloying elements) will be carried out. These experiments are intended to determine such a segregation level of various elements where the composite structure formation is slowed down. It is also proposed to assess the influence of overheating of a melt zone and convection on the planar front stability.

The obtained data will allow us to work out recommendations for the eutectic and non-eutectic DS on the ground.

References

1. Gridnev V. N., Barabash O. M., Buria I. V., Legkaya T. N. Crystallographic features of growth and structural perfection of a two-phase Ni-Nb-C eutectic alloy, depending on the directional solidification velocity // *Kovove materialy*.—1989.—N 2.—P. 129—136.
2. Barabash O. M., Legkaya T. N. Phase transformations and formation of the oriented γ/γ' -Mo₂C structure in the Ni-Mo-Al-C system // *Met. Phys. Adv. Techn.*—1996.—18.—P. 993—999.

«Brazing» Experiment

CAPILLARY PROPERTIES OF METAL MELTS, NON-METAL MATERIALS AND PROCESSES OF WETTING AND BRAZING UNDER MICROGRAVITY

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The experiment pursues two main objectives.

The first one is to test one of the fundamental laws of physical chemistry on the surface phenomena, namely the second capillarity law about the independence of wetting contact angle on gravity [1, 2]. It is intended to carry out measurements of wetting contact angles under normal conditions and microgravity in low-temperature systems, where both wetting ($\Theta < 90^\circ$) (water, glycerine — polyvinylchloride, nylon) and non-wetting ($\Theta > 90^\circ$) (water, glycerine — paraffin, teflon) are observed. The solution of this problem will provide an answer to the fundamental question of whether Young's equation

(1), which has been used for almost two centuries now, holds true or whether wetting contact angles and all the related processes depend on gravitation:

$$\cos\Theta = (\sigma_{sg} - \sigma_{sl})/\sigma_{lg} \quad (1)$$

(Θ is the contact angle; σ_{sg} , σ_{sl} and σ_{lg} are the surface tensions at solid-gas, solid-liquid and liquid-gas interfaces, respectively).

This answer will allow not only a correct interpretation of the obtained results, in particular concerning liquid phase sintering, but also developing experiments and technological processes with use of

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.

References

1. Tatarchenko V. A. Peculiarities of Crystallisation in Capillary Shape Formation in Space // *Technologicheskoe Experimenty v Nevesomosti*. — Sverdlovsk: AS USSR, Ural Sci. Centre, 1983.—P. 101—115. (in Russian).
2. Space Materials Science. Introduction to Space Technology Scientific Background / Eds B. Foerbaier, G. Hamaker, R. I. Nauman. — M.: Mir, 1989.—P. 478 p. (in Russian).
3. Chicu Ph. U. U. S. Astronaut Experiment with Soldering in Space // *Weld. J.*—1993.—N 10.—P. 47—48.

«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 in-

dustrialised countries. An essential obstacle in this path is the presence of the gravitational field of