concerning the operating life of mirror helio-concentrator, selection of material for the light-reflecting coating, compatibility of a levitator with the helio-concentrator, and practicability of technological processes.

Direct use of the concentrated solar radiation for heating the levitating sample decreases the need for the scarce onboard electric power that eventually also reduces the mass load of the ISS (supply of solar batteries and converters).

«MHD-COSM» Experiment

DEVELOPMENT OF ELEMENTS OF PRINCIPALLY NEW MAGNETO-HYDRODYNAMIC TECHNOLOGY FOR MAKING ALLOYS WITH THE PEQULIAR STRUCTURE UNDER MICROGRAVITY

Dubodelov V. I., Kyryyevskyy B. A., Seredenko V. A.

Physical-Technological Institute of Metals and Alloys, NAS of Ukraine
34/1 Akademik Vernadsky Ave., Kyiv-142, 03680 Ukraine
Tel: (380) +44 +444 20 50, fax: (380) +44 +444 12 10, e-mail: metal@ptima.kiev.ua

Shcherba A. A.

Institute of Electrodynamics, NAS of Ukraine
56 Peremoga Ave., Kyiv-57, 03680 Ukraine
Tel: (380) +44 +446 01 51, fax: (380) +44 +446 94 94, e-mail: ashch@ied.kiev.ua

Space metallurgy is one of the important fields of space materials science. Use of metallurgical methods in space environment enables metals, alloys, composites and other materials with improved or principally new properties to be produced. Among such materials are pure metals, monotectic and eutectic alloys, alloys with intermetallics, composite alloys and foam metals, which can have special physical, chemical, electrical, magnetic, optical, mechanical and other properties. Conducting the melting in contactless apparatuses under microgravity, the characteristics of these materials can be improved, first of all, due to the absence of density segregation and the negligible natural convection in the liquid state.

Monotectic alloys, which are mixtures of phases with limited mutual solubility as in the solid, so in the liquid state, have been intensively studied under the space conditions. Melts of such alloys form a single-phase liquid at overheating above the critical temperature T_σ owing to the increase of mutual solubility, but reverting to the solid state they undergo the phase transitions of the first and second kind. An essential change of the characteristics of such alloys is observed in disperse and ultra-disperse phase states. However, there are problems concerning an ultra-dispersion of the second phase and a higher level of the uniformity of its distribution in the matrix. These problems are still unsolved either under the ground conditions or in space. There are also other problems of space production of such alloys. In particular, changes occurring during phase transformations greatly complicate the production of a finely dispersed structure of alloys. The top priority in development of space materials science has been given to the physics of weightlessness. The influence of the Earth's magnetosphere, where the majority of the key phenomena are determined by the fundamental processes of magnetic hydrodynamics (MHD), has been only partly taken into account. The action of magnetic fields on the liquid and solidifying alloys is the strongest during phase transformations and it is registered even in the weak ($1 \cdot 10^{-3}$ T) fields. The influence of a magnetic field on monotectic systems in phase transformations is still unstudied.

One of the objectives of the proposed experiment is to overcome the unfavourable effects appearing in production of monotectic alloys in space. Unlike the space experiments conducted in the past, we suggest to release a heat directly in the alloy for its further melting, as well as to apply a metallic cooler for achieving a higher rate of heat removal from the melt during its crystallisation. We would like to study the influence of magnetic field both on the nature of phase transitions in monotectic melts and on the parameters of crystallisation.

During the experiment, an external uniform constant magnetic field will be applied to the liquid monotectic alloy with the intensity greater than that of the geomagnetic field. During this impact under the conditions of space vehicle, the processes of a marked weakening of the natural thermo-gravitational convection ($g \leq 10^{-3}g_0$) and suppression of the convective flows of any nature promoted by the influence of the electromagnetic force in the melt, will be combined. Earlier experiments demonstrated that some kinetic problems hinder the homogenisation of a monotectic melt above temperature of the binodal. Taking into account these factors, we propose to use MHD methods for homogenisation of a single-phase fluid.

To optimise parameters of a given MHD-system for making monotectic alloys with a finely dispersed structure under microgravity, a comprehensive solution will be a combination of the following items:

— performance of mathematical and physical modelling;

— selection of potential variants and conducting experiments on the ground and in space;

— applying the technique of successive complication of the problem.

It is intended to start the research on optimization of a number of features of MHD-technologies from low-temperature «bismuth-gallium» alloy.

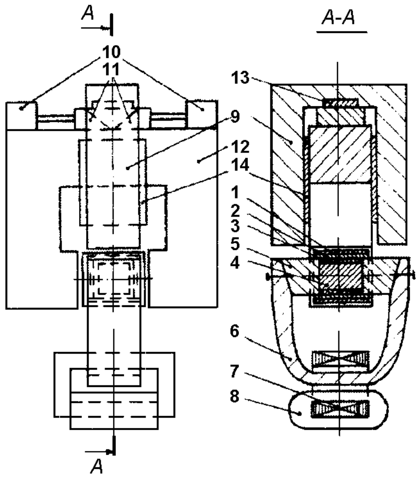

Fig. 3. Schematic of the technological unit (1 — copper capsule; 2 — ceramic cartridge; 3 — elastic heat insulator; 4 — alloy; 5 — copper electrodes; 6 — electrode bus; 7 — transformer core; 8 — transformer winding (primary); 9 — solid aluminium cooler; 10 — manipulator of the magnetic type; 11 — electromechanical cotter pin; 12 — permanent magnet; 13 — ferromagnetic lamina; 14 — slides of the cooler

The schematic of the technological unit is given in Fig. 3.

«MAGELLAN» Experiment

DIGITAL PRECISION SENSOR OF SUPERLOW ACCELERATIONS

Dem'yanenko P. A., Zinkovskiy Yu. F., Prokof'ev M. I.

National Technical University of Ukraine «Kiev Polytechnic Institute»
12 Polytechnichna St., NTUU «KPI», RTF, 17, Kyiv 03056 Ukraine.
Tel: (380) +44 +441 18 31, fax: (380) +44 +241 86 85 e-mail: pmi@ucl.kiev.ua

The accelerometer is based on the fiber-optic sensor (FOS) of superlow linear accelerations with time-pulse modulation of optical radiation intensity [1]. For a long time, the FOSs have attracted the attention of designers by their advantages in performance against the traditional (electric) sensors, but the poor metrological parameters of the classical (analogue) FOSs prevent their wide application.

Analysis of this problem has brought us to the following conclusion. To increase the accuracy of measurements using FOS, it is necessary to eliminate analogue modulation of the optical flow and use its discreet modulations, thus adding new, non-optical, parameters to the optical flow, which will serve as recipients of information. It permits preserving all the advantages of the FOSs, since the optical flow remains to be the carrier of information. Furthermore, the problem of measurement accuracy will not be connected with the problem of measurement of low-level intensity of the optical flow. It is transferred from the area of optical measurements into another, non-optical area, where these problems have been properly solved. We have developed a new class of precision FOSs (Fig. 4) with time-discrete (pulsed) modulation of the optical flow intensity. The target signal is the temporal sequence of optical signals. Information parameters of such a sequence are as follows:

— quantity of pulses as such (the process of measurement is reduced to calculation of pulses,