rator will be equipped with precise tracking system for solar observations. This system will correct for the ISS's vibration and will be located on the outer platform of the URM. The characteristics of helio-concentrator are as follows:

— total power consumption is not more than 300 W;

— diameter of concentrator is up to 2 m;

— weight of mirror concentrator is up to 5 kg;

— focal distance is equal to 0.85 m;

— power concentration coefficient is about of 3000...5000;

— density of the heat flow in a focal spot of 0.01 m diameter is equal to 12000 kW/m^2.

- A complex of self-contained measuring instruments to control the loss of weight, charge accumulation, change of internal structure and surface temperature of test specimens of materials

(*author:* Surdu M. N.).

The measuring equipment developed by the State Scientific & Industrial Enterprise «Spetsavtomatica» is the hardware for system implementation, which may be integrated into a common information system by the onboard computer. The onboard computer should process the information in real time and compress it for telemetry. The measuring equipment is self-contained. Designed to vibration survival, the proposed measuring equipment will have the volume of about 150...200 cm^3 (excluding the volumes of the sensor and the studied test specimen), and the weight of not more than 100...200 grams. It will be able to operate within the temperature range of −40...+50°C and will bear g-loads during injection into orbit. The measuring equipment should be installed in a pressurised module.

- Fiber-optic sensor of atomic oxygen and radiation (designed by the Canadian Institute for Space Researches of the University of Toronto (UTIAS)). Upgrading of this sensor will be done by the Yangel State Design Office «Pivdenne».
- Space Ionic Micro-Analyser «SIMA»

(*author:* Cherepin V. T.)

On-board space ionic micro-analyser (SIMA) for local and layer-by-layer analysis of materials by the method of secondary ion mass spectrometry will have the following characteristics: total weight of up to 60 kg, power consumption of up to 60 W, localisation better than 10 microns, resolving power equal to 50 Ë and mass numbers in the range of 1...200. It will permit analysis of all the elements of the Mendeleev periodic system with up to 10 % response. SIMA will also permit remote-control analysis. This device is intended for conducting various materials science experiments, e. g., on study of corrosion under the actual space conditions, degradation of solar panels, nature and composition of various contamination on the ISS structural elements.

A ground-based facility will be used to improve the methods of study of the space factor influence on materials. It includes a 6-factor simulator of the KIPHK SDTO of the Institute for Low Temperatures Physics and Engineering (*author:* Abraimov V. V.), the helio-plant system of the I. N. Frantsevich Institute for Materials Science Problems in Kiev, and the Crimean Helio-Laboratory (authors: Trefilov V. I., Skorokhod V. V., Pasichny V. V., Frolov G. A., Stegnij A. I.).

«Astro» Sub-Experiment of the «Resource» Experiment

DEVELOPMENT OF BEARINGS AND TURBINE ROTORS AND OTHER FRICTIONAL PARTS MADE OF CERAMICS

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The purpose of the experiment is development of bearings and turbine rotors and other frictional parts for space industry, which are made of zirconia-based ceramics with magnesia and yttria stabilisation systems and of titanium intermetallic compounds.

Mechanical devices and moving parts are vital units for the actual and future space missions. Failures or degradation of such basic mechanical components as bearings and seals may impair a mechanism performance or interrupt a spacecraft operation. The designers consider zirconia-based ceramics as an ideal material for the space/vacuum applications in a wide temperature range, as well as for their application in severe conditions of corrosion (rocket fuel), abrasive (dust of planet surface) environments and thermal cycling. Equally important is application of ion conductivity of zirconia for electric power generation by the fuel cell technology and for air regeneration during the space missions.

That is why materials engineering for bearings and related devices of spacecraft mechanisms using zirconium ceramics should be considered as an innovation. It is known that NASA considered such a kind of projects as far back as 1995.

Intermetallic compounds based on titanium, like titanium aluminides Ti_3Al and TiAl, and on titanium strengthened with disilicides $Ti_5(SiAl)_3$ are promising materials for manufacturing various parts and components of spacecraft and mechanisms. Eutectic mixtures of these intermetallic compounds obtained by the conventional melting or granular powder metallurgy have the strength of 610—640 MPa at the temperature of 800°C and the fracture toughness K_{1c} of about 17—30 $MPa \cdot m^{1/2}$ at 20—800°C at the current stage of development. Their high hardness (460 HV) and hard silicide phase ensure a good abrasive stability. Their friction coefficient with no lubricant is about 0.28.

These innovations are relevant and important for solving the problems of long-time operation and reliability of different spacecraft mechanisms.

To prevent the smallest defects leading to a catastrophic failure at mechanical loading, we propose to make and to test those products under microgravity, which are based on zirconium ceramics and titanium intermetallic compounds. They are characterised by strengthening due to the phase transformations on the ground and, hence, by higher fracture resistance, tribotechnical and functional properties, as well as controlled heat conductivity.

The knowledge obtained during these space experiments will be used to create high-strength and abrasion-stable ceramics and intermetallic compounds for gas turbines, highly effective explosion engines, and artificial biological implants, like the hip joints and teeth.

Our confidence is based on the positive results of zirconium ceramics applications in bearings of chemical pumps, different rotating components of coal-mine equipment, drawing plates in aluminium wire production, pointed bearings of high-precision mechanisms and so on. Authors have a long-term experience in the field of R&D of zircon and other ceramics, for example various units of the explosion engine, such as pistons, valves, turbines and other structural parts, have been made using titanium intermetallic compounds.

«Protection» Sub-Experiment of the «Resource» Experiment

INFLUENCE OF SPACE FACTORS ON PROPERTIES OF METALLIC AND CERAMIC COMPOSITIONS WITH COATINGS

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It is proposed to study properties of compositions on Ti-Al base with oxidation-resistant coatings (800—1000°C) used in aerospace industry, under the influence of various space factors.

The main disadvantage of similar alloys for coatings regarding the degradation of their fatigue life can be eliminated by development and application of a new kind of alloys. These alloys are based on gamma Ti-Al system modified by REM and Sc, which are able to change the reactivity of the Al/Ti components in the environment. As a result, an alumina will form on the surface of the alloy with