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

Oliker V. E.

I. N. Frantsevich Institute for Materials Science Problems, NAS of Ukraine
3 Krzhyzhanovsky St., Kyiv 03142 Ukraine
tel: (380) + 44 +444 10 90, fax: (380) +44 +444 21 31, e-mail: oliker@ipms.kiev.ua

Kresanov V. S.

National Technical University of Ukraine «Kyiv Polytechnical Institute»
12 Politechnicna St., Kyiv 03056 Ukraine
tel: (380) +44 +441 18 31, fax: (380) +44 +241 86 85

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 saving of sufficient mechanical properties of the substrate (ultimate tensile strength is about 400—500 MPa at 800°C). The coatings have been formed by detonation spraying.

A special device will be designed to test the new material samples for fatigue strength. This unit consists of the loading device mounted on the outer side of the ISS, and of the automatic control and recording systems placed inside the ISS. The loading device is a carousel-type holder with 15 specimens, which are subsequently loaded in a cycle. Loading rollers are arranged in two circular rows in such a manner that the free ends of plane specimens are clipped for bending between them. The loading device is driven to rotation by a motor. The automatic control system records the holder revolutions, temperature, and time by the signal transducers mounted on the loading device.

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

PROPERTIES OF METAL HYDRIDES UNDER MICROGRAVITY

Trefilov V. I., Schur D. V.

I. N. Frantsevich Institute for Materials Science Problems, NAS of Ukraine
3 Krzhyzhanovsky St., Kyiv 03142 Ukraine
tel: (380) + 44 +444 22 71, fax: (380) +44 +444 03 81, e-mail: shurzag@ipms.kiev.ua

The purpose of the experiment is to study the effect of microgravity on performance of energy conversion systems and other apparatuses based on metal hydride materials. This experiment also involves a study of hydrogen-sorbing materials production in space and of their physical and chemical properties. Such materials may be widely used in the future to design the space hydrogen power devices.

These data will be compared with the data obtained on the ground under the gravity conditions.

Experiment program includes the following stages:

- study of the peculiarities of the process of production of hydride-forming alloys;
- study of the influence of microgravity on physical-chemical transformations arising in application of hydrogen energy equipment;
- design, development, fabrication and testing of metal hydride storage facilities for hydrogen transformation and use onboard the OSS to perform scientific experiments;
- study of fatigue life, hydrogen capacity, structural and phase characteristics of alloys and of products of their interaction with hydrogen;
- production of various fullerenes under microgravity;
- comparative study of heat mass transfer and thermal-physical properties of metal hydride powders under the conditions of full gravity and microgravity;
- study of the influence of microgravity on the performance of a metal hydride electrode for batteries.

This work is carried out in wide co-operation with the institutions and laboratories in Ukraine (IPMS NASU; Institute for Problems in Machinery, NASU; State Scientific Industrial Enterprise «Zirconium»), Russia (Institute of New Chemical Problems, RAS; Institute of Chemical Physics, RAS), the USA (University of Central Florida; Allied Signal Inc. Aerospace Equipment Systems; Eastern Europe Linkage Institute), Canada (Ecole Polytechnique de Montreal), and Germany (Institute for Nuclear Energy and Energy Systems of the University of Stuttgart).