CONCLUDING REMARKS

Scientific research and technological experiments presented in this special issue is an important contribution of Ukrainian scientists and engineers into the ISS project.

These experiments will give principally new knowledge in such fields as space technology and materials science, Earth sciences, solar astrophysics, space biology and biotechnology, space medicine, solar power engineering, study of the physical-chemical processes under microgravity, planning and management of on-board experiments in the orbital complex.

The *«Space technology and materials science»* Chapter contains information on three integrated projects aimed at study of the influence of space factors on characteristics of the ISS elements and units as well as on properties of various materials.

The experiments of the «Material» project have a common purpose to make materials under microgravity conditions with new useful properties, which cannot be produced under the effect of terrestrial gravity. The processes of heating, melting, spraying, cooling, and crystallisation are used for producing the samples. However, tasks, methods, objects of study, and applied equipment differ essentially in these experiments. The measuring and registering systems for all the experiments are rather similar and can be unified.

The influence of space factors and microgravity on mechanical, tribotechnical, and optical-physical parameters of materials and coatings is studied in the integrated «Degradation» project. Special attention is paid also to development of new on-board scientific equipment, its power supply and thermostabilization systems (heat setting), as well as to ground-based simulation of the influence of space factors on various materials.

The third «Diagnostics» project deals with the methods and equipment for control of defectiveness and stressed state of space constructions.

The *«Research of the Earth and near-Earth space»* Chapter contains five integrated projects, which are related to contact diagnostics of plasma and gaseous environment of the ISS, study of the Earth's upper atmosphere by the optical and millimeter-wave technique, study of the Earth's ionosphere, remote sounding of the surface and water area of Earth, active experiments in space and on the Earth's surface.

An integrated approach to measurement and analysis of the basic parameters of gaseous and plasma environment of the station (concentration of particles, mass content, temperatures of electron and ion components, power spectra, effective scattering cross-sections, plasma potentials, pressure, electric and magnetic intensities, etc.) is proposed in the «Environment» project.

The «Inframon» project deals with continuous and long-term monitoring of the events occurring on the Earth's surface, in the atmosphere and in the near-Earth space. The apparatus proposed by the authors can be incorporated into a common measuring complex allowing research to be completed simultaneously in the high-frequency range of the electromagnetic wave spectrum.

In the «Space» project a new procedure of global near-Earth plasma monitoring with the method of radio sounding by signals of the ground-based HF and EHF broadcasting radio and television stations, received on board the ISS is proposed.

The «Surface» project deals with a series of experiments to study the Earth, water area and natural environment of Earth in optical, infrared, millimeter, centimeter, decimeter, and meter ranges of waves and to improve methods of the Earth Remote Sensing.

This Chapter also contains a description of active experiments in space, including such an important task as a development of a technique for experimental research of orbiting object characteristics, which evaluates the risk of operating spacecraft being damaged by space debris.

Two experiments described in the *«Astrophysics and extraterrestrial astronomy»* Chapter are in the field of solar astrophysics. One of the experiments deals with observations of magnetic field and plasma conditions of various formations on the Sun with the high resolution up to $0.2''$, which has never been reached in previous experiments. The second experiment is intended for long-term measurements of the solar radiation flux with the subsequent calculation of the proper frequencies of its oscillations. The relative amplitudes of these oscillations are equal to $(1—10)\cdot 10^{-5}$. Stringent metrological requirements for stability of parameters of the radia-

tion sensor and for the time interval precision are imposed to detect such a weak signal.

The program on space biology, biotechnology and medicine described in the *«Space biology, biotechnology and medicine»* Chapter envisages gaining of principally new scientific knowledge about the mechanisms of biological effects of microgravity at the population, organism, cellular and molecular levels as well as development of concepts on cell gravisensitivity and growth, development, reproduction, and resistance of organisms in microgravity. It will promote creation of the space cell biotechnology for medicine and agriculture, express-methods for ecological monitoring of the biosphere, as well as development of new technologies for the Controlled Ecological Life-Support Systems (CELSS). These priorities of the program are based on the statement that proliferating and actively metabolising cells are the most sensitive to the influence of microgravity.

The principal investigations of Ukrainian space biologists have been carried out in the field of gravitational biology. For this reason, a significant number of biological experiments on board the URM are intended to verify the conceptual ideas of the Ukrainian scientists in this field. New methodological approaches to performance of the space and ground-based experiments with clinostats and centrifuges are considered as well. A considerable attention is also paid to space medicine directed to protection of human health, improvement of the quality and duration of the astronauts' life in a long-term space flight.

The project of the *«Space solar power engineering»* pursues further development of the theory of processes of solar energy conversion into electric energy and its transmission to remote users in the space environment as well as creation of adequate mathematical models and study of the dynamics of advanced technological structures in solar power engineering as specific mechanical systems.

The experiments described in the *«Physical-chemical processes under microgravity»* Chapter are concerned with the basic problems of physics of liquids and materials science. The first described experiment deals with study of the microgravity influence on parameters of heat exchange and dynamics of the vapour phase in boiling of liquid helium. Other experiments deal with producing new materials under microgravity, i.e. composite materials from immiscible components with use of the method of ultrasonic excitation and the eutectic alloys of Ni-Nb-C system by the method of electron beam zone melting. Experiments on processes of directional crystallization under microgravity with three-dimensional preparation and of soldering composite ceramics and glasses with molten metal solders are performed too. 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. This method will be used in the unique «Technology» experiment for making a flight unit to conduct the electron beam CZM under microgravity on board the ISS.

The *«System analysis»* deals with planning and management of on-board experiments at the scientific orbital laboratory in the structure of the ISS.

The projects of scientific research and technological experiments described in this issue have been recommended by the CCOSS for realization onboard the Ukrainian Research Module of the ISS. They could also serve as the database for preparing joint international proposals. As the first step in this path the appropriate American and Ukrainian organizations have selected several bilateral projects, which will be funded by the USA according to a Memorandum of Understanding signed in 1999. Negotiations are now in progress between the Russian and Ukrainian specialists for specifying joint Russian-Ukrainian projects.

Not with standing the prospect of the Ukrainian Research Module, the authors hope that their vision of conducting the scientific research and technological experiments onboard the ISS will be useful for the ISS community, and that the great ISS project will be realized for benefit of mankind.