Space Technologies and Analytical Systems

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The development of technologies directly in outer space, including space stations or special space technology complexes, is an interesting and important task today.

One of the most important tasks in the development of the outer space of the solar system is the task of providing energy to space complexes, the natural source of which is the Sun itself. This is the first step to mastering the energy of its Star, marking the transition to civilizations of the second type (on the Kardyshev scale). The construction of Dyson's sphere is a distant prospect and whether our civilization will be able to reach the level at which this task will become a reality is still a big question, but we can do steps in this direction now and now. A necessary step along this path is the stage of mastering the technologies for constructing efficient systems of solar energy conversion and accumulation, the first step to which the proposed technological cycle for the development of solar converters based on the elements of the third and fifth groups of the periodic table can be proposed.

The project in this direction has been conducted for more than 10 years with the participation of scientists from the Siberian Branch of the Russian Academy of Sciences, groups from the Physico-Technical Institute of Kazakhstan and the Institute of Nanotechnology of the University of Houston (USA). The first technological module should be ready for launch on the ISS in a year and a half. The project is financed by the company ROSKOSMOS (Russia).

An essential element of technology implementation is the provision of the technological module with adequate analytical equipment. At present, it seems that it is expedient to use atomic force microscopy as the basic analytical and measuring equipment, which makes it possible to control a number of surface properties: topographic analysis, rigidity with a numerical definition of the Young's modulus, friction forces, adhesion properties of materials, , Photoemission properties, piezoelectric properties of surfaces. When the properties of the system are extended, integration of spectral methods in combination with atomic force microscopy methods is also possible. In this case, it becomes possible to register not only the physical properties of surfaces, but also the registration and identification of surface functional groups, which makes it possible to optimally optimize the technological processes of the formation of functional elements.

The analytical technique of the station can provide for the needs of the technology, as well as the possibility of studying and controlling the degradation processes of various materials in conditions of orbital space flights. Changes in the structure and parameters of materials occur under the action of near-Earth plasma and are not currently fully understood.

The first versions of atomic force microscopes for NASA were developed in the early 2000s (http://www.lpi.usra.edu/meetings/robomars/pdf/6200.pdf). The prospect of using devices of this type was obvious, but the state of their development was not yet sufficient. The element base and achievements of recent years can make these devices promising for both developing technologies and controlling materials in space and for using them to control materials under extreme operating conditions.