

Prospects of Equipment Use for Scientific Research

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Abstract: In study characteristics of the unique scientific objects created in a number of scientific and educational organizations are described. By the analysis results the important features of unique scientific objects created to solve scientific tasks and questions of devices use prospects and possibilities of using the equipment for carrying out scientific research are revealed.

Key words: Unique scientific objects, USO, devices, equipment for scientific research, prospects, Russia

INTRODUCTION

Development and successful functioning of the country's modern scientific sector for carrying out researches and developments is impossible without propelling research infrastructure, part of which being the research equipment, complexes and unique scientific devices (Kachak *et al.*, 2013; Moiseenko and Kostenko, 2015).

High scientific capacity of the scientific and educational organizations in which the centers of the scientific equipment collective use of both unique stands and installations are created, allows to conduct researches on various priority directions of science, technologies and equipment development in the Russian federation (Kachak and Maslennikov, 2014).

Scientific devices and equipment of the scientific and educational organizations enable the interested research collectives and certain researchers to conduct scientific research on various subjects that is confirmed by their demand in various spheres including obtaining new solutions for scientific problems of fundamental and applied character (Moiseenko and Kostenko, 2015; Moiseenko *et al.*, 2016a and b).

MATERIALS AND METHODS

Characteristics of unique scientific objects for carrying out researches: The Unique Scientific Objects (USO) created in the educational and scientific organizations have their own unique potential and advantages for carrying out scientific research. Among examples of the unique scientific equipment it is possible to give, first of

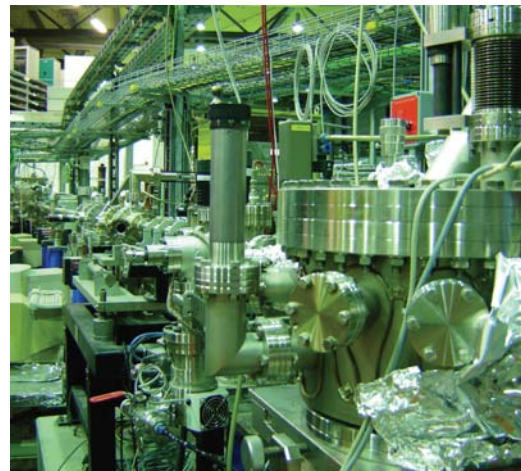


Fig. 1: A unique complex with certification and research stands of experiments preparation in St. Petersburg State University

all the unique complex with certification and research stands of experiments preparation created in St. Petersburg State University as well as high-rise polarizing lidar "Stratosphere-1M" of the national research Tomsk State University (Fig. 1) (Moiseenko *et al.*, 2016a, b).

A unique complex presented in the drawing is intended for the solution of a wide range of tasks in the field of nanotechnologies and material's science where detailed information on atomic and electronic structure on chemical condition of atoms/molecules, on their dynamics, on interaction between electronic and atomic subsystems, properties of nanosystems, including magnetic, kinetics

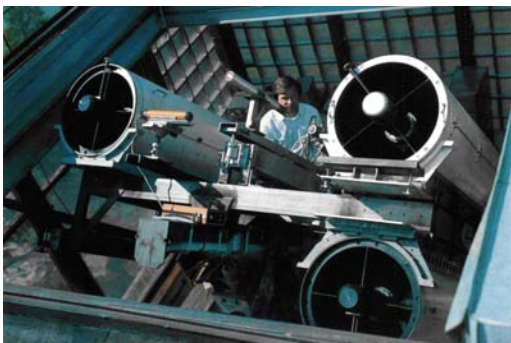


Fig. 2: High-rise polarizing lidar “Stratosphere-1M” in the National Research Tomsk State University

of their changes of induction character and their influence on physical and chemical properties of systems is required.

Use of a complex unique opportunities allowed to develop a new method of determining parameters of nanodimensional local structure of substance on the basis of the x-ray absorption ranges analysis as well as to determine consistent patterns of atomic and electronic structure of nanoneedles in a new class of materials-magnetic semiconductors (Fig. 2).

USO “Stratosphere-1M”-is the Russia’s first high-rise polarizing lidar which according to the characteristics is the only experimental installation in the world for measuring the high-rise profiles for all elements of the light return dispersion matrix for atmospheric aerosol.

With use of USE monitoring of the aerosol asheric particles in the atmosphere is carried out, wave processes in the atmosphere, mechanisms of crystals orientation in plumose and nacreous clouds are investigated; scientific problems of the directions are solved: microphysics and dynamics of clouds; stratospheric aerosol and ozone; solar wind and aerosol in the average atmosphere; global transfer of natural and anthropogenous aerosols.

By means of a high-rise lidar quantitative data on parameters of crystal particles orientation in clouds of the top tier which are extremely important for creating the adequate optical model considering anisotropic properties of the disseminating environment, consisting of ensemble of mainly focused particles are for the first time obtained (Moiseenko *et al.*, 2016a, b).

Among other examples the 1.2 m telescope created at the Ural federal university of the first president of Russia B.N. Yeltsin should be noted it is equipped with the Russian single unique fiber optical echelle spectrograph of high resolution designed according to the scheme of a white pupil. Degree of uniqueness for one more USE of the Ural university, the 70 cm telescope is characterized by existence in its structure of a unique multichannel

electrophotometer which creates an opportunity for simultaneous observations of the studied star, stars of comparison and a background of the sky to receive world-class results of accuracy in astroclimatic conditions of middle latitudes.

As remarkable addition of USE characteristics the IRT-T research reactor of the Tomsk polytechnical university for carrying out research on physics of a solid body, neutron activation to the analysis of element composition of substances, production of radionuclides, an alloying of silicon, neutron radiography, performance of other researches acts.

The closest world analog of the IRT-T research reactor is the reactor installation of Massachusetts Institute of Technology (MIT, USA). Unique feature of the IRT-T reactor is use of the central beryllium trap allowing to provide density of a thermal neutrons stream in the central experimental channels 10 times more than in the MIT reactor.

Among unique achievements of USE should be noted that this unique scientific object researches on a neutron and transmutational alloying of silicon and has special value for development of the radio-electronic industry. Quality of the irradiated silicon received on the reactor is one of the best in the world.

Due to the available personnel potential use the USE allows not only to reach high rates of substances and materials production but also indicators of successful scientific and educational activity.

Among the unique scientific objects created in the scientific organizations it is possible to name a spherical “Globus-M” tokamak of physics and technology institute of A.F. Ioffe of the Russian academy of sciences. It should be noted that in the world there are only two similar spherical tokamaks equipped with potent power supplies and plasma heating, as well as complicated diagnostic equipment for carrying out complex researches of plasma. It is the NSTX installation (the princeton laboratory of plasma physics, USA) and MAST (kalemsky scientific center “Sintez”, great Britain).

Uniqueness of the “Globus-M” tokamak is characterized by existence of the plasma gun which does not have world analogs for carrying out researches and tests as well as use of methods for carrying out researches on non-inductive maintenance of plasma electromagnetic radiation current.

RESULTS AND DISCUSSION

Use of scientific and technical potential for carrying out researches: For the characteristic of use prospects for scientific and technical capacity of the scientific and

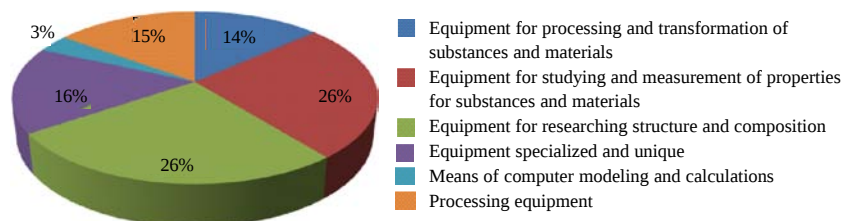


Fig. 3: Distribution of the equipment on scopes

educational organizations for carrying out researches information on quantitative and qualitative structure of scientific devices and the equipment their cost and other parameters are important.

According to the federal catalog of the hi-tech equipment and objects of scientific potential in Russia there are about 36 thousands of scientific devices and equipment. From them of the Russian production-over 16 thousand units that makes 46.9% of total devices and equipment number. The book value of devices of the Russian production makes over 35 billion rubles. The number of the most expensive equipment worth over 1 million rubles makes 13.5 thousand devices which book value makes over 98 billion rubles, devices of the Russian production make 33% of them (Moiseenko *et al.*, 2016a, b).

Expenses on science in 2015 made over 439 billion rubles (2.81% of the federal budget expenses). Internal current costs of research and development in 2015 in actually operating prices made over 854 billion rubles of them on acquisition of the equipment 28 billion rub. Positive dynamics of the equipment costs remains since 2000 with average annual growth rate of 1.66%.

The given statistics proves high dependence of domestic research and development sector on the import equipment and accessories, as well as the high cost of the specified equipment (Moiseenko *et al.*, 2016a, b).

The analysis of instrument base of the scientific equipment collective use centers which part also make unique scientific objects, showed that their instrument park contains >10 thousand devices of which >30% of total make devices of the Russian production. The main part of the equipment 65-70% was acquired or modernized during 2001-2010. At the same time it is important to understand that carrying out research and development at the modern level is impossible without continuous updating of the instrument park. Distribution of the equipment for scientific research on scopes is given in Fig. 3.

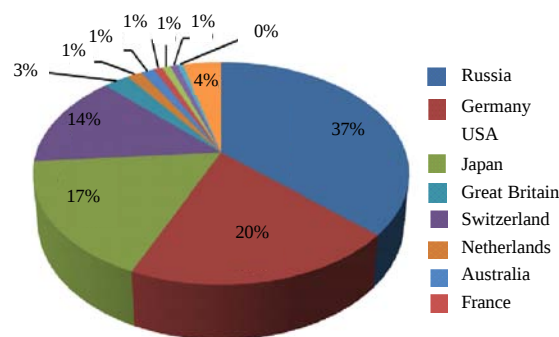


Fig. 4: A ratio of the Russian and foreign scientific equipment used for structure and composition research of substances and materials

As appears from Fig. 3 the most significant part of the instrument park of the research equipment is the equipment for composition, structure and properties research for substances and materials which includes the analytical scientific equipment of microscopy, spectrometry, chromatography and the x-ray analysis and makes about 26% of total amount of the devices and equipment park in the country. Existence of the modern complex analytical devices possessing high technical characteristics and wide range of functionality allows to conduct multimethod cross disciplinary researches in various fields of science and to receive world-class results (Moiseenko *et al.*, 2016).

Important indicator of scientific and technical potential use for carrying out researches is the share of the Russian devices in the general mass of the high-precision analytical equipment. Data on a percentage ratio of the Russian and foreign scientific analytical devices and the equipment used for structure and composition research of substances and materials are provided in Fig. 4 (Moiseenko *et al.*, 2016a, b).

Apparent from Fig. 4 the share of the analytical scientific equipment of the Russian production in the

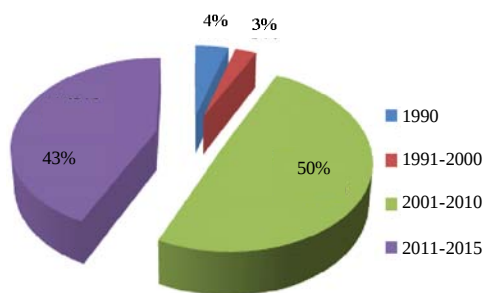


Fig. 5: Distribution of devices and the equipment by YOM

country makes about 40% that proves rather considerable volume of the domestic scientific and technical potential used for carrying out researches and developments.

If to consider the age of scientific devices and equipment then it is possible to note that a half of them is made in the period of 2001-2010 (Fig. 5) (Moiseenko *et al.*, 2016). The data provided on Fig. 5 confirm the approach of physical and moral obsolescence of scientific devices and equipment which indicates their replacements or modernization is needed.

Prospects of creating the scientific equipment: Currently in Russia there are scientific and technical means for developing domestic scientific instrument making, highly skilled personnel and experience of developments and production of the advanced scientific equipment.

At the same time, there is a number of problems connected with creating domestic scientific devices and first of all analytical devices. Mass and spectrometer production can be such example. Scientific potential of mass and spectrometer developments during existence of the soviet union was very high. The scientific mass and spectrometer school of the USSR offered and introduced a number of major inventions which considerably provided modern world level of this branch.

Now the Russian market is sated with the American, European and Japanese companies producers of multipurpose mass spectrometers. For real release and sale of domestic production mass spectrometers it is required to solve a number of problems: creation of the state or public and private company focused on release of mass spectrometers which has to be provided with target financing for carrying out developmental researches, preparation of production and establishing serial release of devices and equipment is necessary state regulation of considerable duty on import of middle class mass spectrometers is necessary.

Summary: Thus, on the basis of the above it is possible to draw a conclusion that the equipment which is

available in the scientific and educational organizations possesses an important role in use of scientific objects infrastructure. Unique scientific devices and equipment of scientific and educational organizations create a certain scientific and technical reserve for carrying out researches and developments which at the same time testifies to expediency of its timely updating.

CONCLUSION

Use of research objects infrastructure proved the demand for carrying out researches, tests, measurements and obtaining significant scientific results. It is possible to draw a conclusion on use prospects of devices and equipment of the scientific and educational organizations for carrying out researches on the priority directions of developing science, technologies and equipment in the Russian federation.

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REFERENCES

- Kachak, V.V. and A.M. Maslennikov, 2014. Assessing the centers network of collective use of the scientific equipment taking into account the priority directions of science technologies and equipment development in the Russian federation. *Innovation*, 1: 55-59.
- Kachak, V.V., E.S. Masterskih, V.E. Moiseenko and A.V. Kostenko, 2013. Unique scientific objects of higher educational institutions-information and staffing. *Integral*, 73: 127-130.
- Moiseenko, V.E. and A.V. Kostenko, 2015. Development of information support of unique scientific objects of higher educational institutions: Topical issues of science. *Proceedings of the Materials XXII International Conference on Scientific and Practical*, November 10, 2015, Petersburg State Transport University, Saint Petersburg, Russia, pp: 30-31.
- Moiseenko, V.E., A.A. Vasin, A.V. Kostenko, Y.O. Pozdnyakov and H.A. Ramazanov, 2016. Devices and equipment for scientific research: Possibility of import substitution. *Innovations Investments*, 11: 189-194.
- Moiseenko, V.E., A.V. Kostenko and A.A. Vasin, 2016. Information support of the higher educational unique scientific objects. *Intl. J. Soft Comput.*, 1: 90-92.