

On the 60-year jubilee of Machulin Volodymyr Fedorovich Academician of NAS of Ukraine



23 April 2010 is the jubilee date in life of Academician of NAS of Ukraine Machulin Volodymyr Fedorovich: he has reached 60-year age.

All the scientific activity of V.F. Machulin is tightly related with V. Lashkaryov Institute of Semiconductor Physics where he began to work in 1973 after completing its education with honors degree in Kyiv Polytechnical Institute (nowadays it is called as National Technical University of Ukraine “Kyiv Polytechnical Institute”). In 1978, he defended its candidate thesis and in 1995 – its doctor thesis. V.F. Machulin is Laureate of two State Prizes of Ukraine in the field of science and engineering (1994 and 2003 years). In 1998, he was given with the honorary title “Honored worker in science and engineering of Ukraine”, and in 2007 – with the academic status of professor. In 2000, he was elected as Corresponding Member and in 2009 – as Academician of NAS of Ukraine.

Since 2003, V.F. Machulin has being working in the position of Director in V. Lashkaryov Institute of Semiconductor Physics. He is the Head of the Department for Structural and Element Analysis of Semiconductor Materials and Systems in this Institute. Simultaneously, he is the Head of Highest Attestation Commission of Ukraine.

The main scientific works by V.F. Machulin are aimed at studying X-ray diffraction phenomena in semiconductor materials and nano-structures as well as development and practical applications of methods for high-resolution investigations in diagnostics of real structures of weakly disturbed crystals and quantum-dimensional systems.

Of great importance are his works devoted to studying physics of dynamic scattering of X-rays in real crystals in the most difficult case of complex defect structures that simultaneously consist from localized and distributed deformations and composition. In this relation, extraordinary informative became ascertaining the regularities in X-ray dynamical diffraction in crystals that contain static and modeled acoustic deformations of the structure.

The value of these investigations acquires now a particular meaning, if taking into account the strategic interest of our state to develop nano-physics, nano-materials science, nano-technologies and nano-electronics as well as to obtain sub-micrometer structures with physical and physico-chemical parameters and performances set in advance.

Among the most weighty scientific results obtained under the guidance and direct participation of V.F. Machulin, one should note the following ones:

– offered and developed for the first time are the basics for structural diagnostics of real crystals that are based on peculiarities of X-ray optics in crystalline media under dynamic scattering, which enabled to perform analysis of structurally non-homogeneous semiconductor single crystals. Obtained in these investigations is the possibility to separate contribution of structural imperfections of various nature on diffraction parameters of X-ray scattering;

– offered are new roentgen-optic methods that essentially increase possibilities for diagnostics of weak disturbances in crystals. In the pioneer works by V.F. Machulin, using the synchrotron radiation as a source of X-rays that diffract in crystal lattice, obtained for the first time was the unique possibility to observe surface topology of defects in epitaxial systems and its development in the bulk as well as the character of deformation fields accompanying these defects;

– led are the foundations for a new complex roentgen-acoustic method for diagnostics of weakly disturbed crystals with combined deformation fields, which due to high sensitivity, exactness and information capability, enables to ascertain not only the nature of dominating type of crystal lattice defects (micro-defects or macro-disturbances) but to reveal and measure both the level of crystal weak macro-deformations and integrated characteristics of structural perfection;

– made is the weighty contribution to development of physical and physical-and-technical basics for creation of semiconductor device nanostructures, investigated for the first time are the features of relaxation inherent to mechanical stresses in epitaxial systems, determined are the dominating mechanisms responsible for creation of defects in device structures “metal-dielectric-semiconductor”, barrier nanostructures based on $A^{III}B^V$ materials and others, dependences of these mechanisms on technological parameters in the growth process and on the post-growth treatments.

Under direct guidance of V.F. Machulin, there was performed a wide range of investigations aimed at studying the influence of radiations of various nature on semiconductor material and devices based on them. Analyzed were the mechanisms responsible for creation of defects under action of irradiation as well as radiation annealing; offered were new technological processes for treatment of device structures by using short-time powerful microwave irradiation that enhances their stability as to external impacts.

These investigations gave the possibility to offer express methods for integrated estimations of structural perfection inherent to semiconductor and optoelectronic devices as well as facilities based on them, which were confirmed with USSR author certificates and implemented by the open-stock company “Zavod chysti metaly” (Svitlovod’sk, Ukraine). The economy provided by exclusion of unfit articles from the following treatment was approximately 12 to 15% of expenses calculated per production unit.

In accord with requirements of technical documentation, in Ukraine for the first time developed and created were the methods for testing the thickness of a disturbed layer in single crystals, including those with low durability, as well as for testing structural perfection of single crystals, including those containing elements with high atomic numbers. Also created was the testing-diagnostic complex capable to provide automated testing the structural and durability parameters both of semiconductor crystals (systems) and devices based on them during all the stages of their manufacturing.

Methodical aspects of the works devoted to dynamic scattering within the range of braking radiation wavelengths, where the essential role is played by phenomena of abnormal dispersion in real binary crystals, are actively used in synchrotronic centers abroad to perform diagnostics of objects with nanometer sizes (super-lattices, structures with quantum dots and chains of the latter).

The department headed by V.F. Machulin keeps scientific contacts with many scientific-and-research institutes and universities both in Ukraine and abroad, in particular, in Poland, Germany, USA and Finland. As a result of this cooperation, V.F. Machulin repeatedly took part in managing the projects in the frameworks of INTAS and USTC programs. Reports of the Department scientists on international conferences obtained favorable reviews and high appraisals of leading world specialists in the field of X-ray diffraction.

There are 150 scientific works including 5 monographs in the creative heritage by V.F. Machulin. He trained several doctors and candidates of sciences.

V.F. Machulin leads a large scientific-organizational work not only as Director of V. Lashkaryov Institute of Semiconductor Physics but as the Head of the Scientific Council for the problem “Physics of semiconductors and semiconductor devices”, the member of the Committee for State Prizes of Ukraine in the field of science and engineering, the member of Bureau of Department for Physics and Astronomy of NAS of Ukraine, Co-Chairman of the Section for problems of functional materials of Scientific Council for new materials in International Association of Academies of Sciences, Editor-in-Chief of the international journal “Semiconductor Physics, Quantum Electronics and Optoelectronics” (Kyiv).

As the Head of Highest Attestation Commission of Ukraine, V.F. Machulin brings an essential contribution to the affair of improvement and increasing the efficiency of the attestation process for scientific and scientific-and-pedagogical personnel of the highest qualification.

All the members of the Editorial Board wish V.F. Machulin to have a strong health and high creative potential for a long time, to reach new scientific peaks in future.