Physics – Uspekhi **49** (10) 1105 – 1106 (2006)

PERSONALIA PACS number: **01.60.+q**

Mikhail Valentinovich Koval'chuk (on his sixtieth birthday)

DOI: 10.1070/PU2006v049n10ABEH006199

Professor Mikhail Valentinovich Koval'chuk, Corresponding Member of the Russian Academy of Sciences (RAS), outstanding scientist in the field of X-ray physics and crystallography, celebrated his 60th birthday on 21 September 2006.

Koval'chuk was born on September 21, 1946 in Leningrad. Having graduated from the Physics Department of Leningrad State University in 1970 he went to work at the A V Shubnikov Institute of Crystallography of the USSR Academy of Sciences. Here, Koval'chuk rose from trainee researcher to Director of the Institute. He started with simple problems in X-ray diffraction and ten years later organized and headed the Laboratory of X-ray Optics and Synchrotron Radiation, which became one of the best X-ray laboratories and attracted many talented researchers. His broad range of interests, his creative nature, and his ability to rapidly master a new field and succinctly formulate emerging problems and find ways of solving them were the qualities that to a large extent have defined Koval'chuk as a scientist. Taking in 1998 the position of Director of the Institute of Crystallography of the Russian Academy of Sciences (IC RAS), he started the reorganization of the research process at the institute. This was a difficult time for Russian science, so success was ultimately achieved only through Koval'chuk's ability to find a way out of seemingly hopeless situations.

One of Koval'chuk's avenues of inquiry lies in developing X-ray diffraction techniques as applied to structural analysis of various materials, such as the real structure of semiconductor materials in solid-state microelectronics, first and foremost the thin layers that form on the surface of perfect crystals in response to various external actions, for instance, ion implantation, laser irradiation, annealing and so forth. As a result, the electronics industry of the country was equipped with modern methods of diagnostics based on the three-crystal X-ray spectrometer developed under Koval'chuk's guidance.

Since the mid-1970s, Koval'chuk has launched a multifaceted research pertaining to the study and applications of standing X-ray waves. At the initial stage, fluorescent radiation yield was measured under the conditions of dynamic diffraction of X-rays in germanium and silicon crystals. In addition to working on X-ray fluorescence, Koval'chuk studied other inelastic scattering channels, including the external and internal photoeffect (photoconduction), as well as Compton and diffuse scattering. This work pioneered in demonstrating, among other things, the possibility of using the emission of photoelectrons excited by a standing X-ray wave for detecting small atomic displacements (of only a few fractions of the interplanar spacing) in subsurface layers. This fundamental physical result has been put to practical use for studying processes of structural changes that occur in surface layers of semiconductors at various stages of the technological process of manufacturing semiconductor devices for electronics. The results obtained under Koval'chuk's guidance on using Laue-geometry diffraction to localize impurity atoms distributed in the bulk of crystal should be specially mentioned. Koval'chuk generalized the results of the works outlined above in a review (co-authored by V G Kon) published in *Physics – Uspekhi* in 1986.

Mikhail Valentinovich Koval'chuk

In recent years Koval'chuk has worked successfully in a new area of X-ray optics that studies and develops applications of multiwave diffraction. He carried out a series of pioneering works on the analysis of the yield of photoelectrons in conditions of two- and multiwave diffraction. This line of research involving the development of phase-sensitive X-ray methods underpins the work on X-ray holography. Koval'chuk was the first to demonstrate experimentally and theoretically the possibility of two-dimensional localization of atoms in a crystal lattice by recording the yield of secondary emissions under conditions of multiwave diffraction.

Uspekhi Fizicheskikh Nauk **176** (10) 1133 – 1134 (2006)
Translated by V I Kisin

In fact, Koval'chuk's studies added surface sensitivity to X-ray diffraction methods and thereby created the foundation for a drastically new method of structural investigations — the structure-sensitive spectroscopy of surfaces of condensed media using standing X-ray waves. The method is now used efficiently in many laboratories and synchrotron centers throughout the world.

Koval'chuk was one of the first physicists in Russia to recognize the promise of studying the structure and properties of the condensed state of matter using synchrotron radiation not only as a source of high-intensity X-ray radiation (also possessing other useful properties) but also as a platform for concentrating the power of high intellectual potential for driving integrated fundamental and applications-oriented research. He took an active part in the preparation and implementation of the State Science and Technology Program 'Synchrotron Radiation and Practical Ray Applications'.

In 1999, Koval'chuk became director of the Kurchatov Center for Synchrotron Research. He focused his efforts there on creating a network of research stations, paying special attention to the study of nanobioorganic systems.

In the last six years Koval'chuk has been able to complete successfully the implementation of a large-scale scientific and technological project of designing, developing, and launching unique research equipment, namely, experimental stations on the extracted beams of Russia's first specialized synchrotron radiation source for the collective use by the entire scientific community. The implementation of this project is Koval'chuk's important contribution to progress in the experimental and technological potential in Russia for pursuing research in fundamental sciences, materials sciences, nano- and biotechnologies, molecular biology and medical sciences, as well as in the advancement of atomic-resolution diagnostic techniques. In 2005, Koval'chuk was appointed Director of the Russian Research Center 'Kurchatov Institute'.

Koval'chuk has been instrumental in organizing international cooperation in X-ray physics, crystallography, and applications of synchrotron radiation to nanotechnologies and physical materials sciences. An excellent example of this cooperation is the successfully working Russian – German laboratory for synchrotron radiation application [Russian – German Laboratory (RGL) at BESSY].

Koval'chuk is an active science manager and teacher in his capacities as member of a number of editorial boards of scientific journals, Editor-in-Chief of the journal *Kristallografiya*, and Head of the Chair of the Physics of Nanosystems, which was created on his initiative in 2005 at the Department of Physics of M V Lomonosov Moscow State University.

In 1997, Koval'chuk resurrected the Soviet-era tradition of convening All-Union X-ray meetings and started to organize regular National Conferences on the Application of X-ray and Synchrotron Radiation, Neutrons, and Electrons to Materials Research.

Koval'chuk initiated a similar restart of the National Conference on Crystal Growth, which was resumed at the IC RAS in 2000.

Koval'chuk has entered his jubilee year in the prime of his creative powers, brimming with new plans and ideas. He is not afraid of difficulties; he formulates important targets for science and then finds ways of solving all the problems; whatever he works on, he never loses sight of the future. Mikhail Valentinovich is driven by his interest in science, life, people, and is never indifferent to what goes on around him. He is a born leader and a source of new ideas.

Friends and colleagues send Mikhail Valentinovich Koval'chuk heartfelt best wishes and hope he reaches new scientific milestones and continues working fruitfully for the good of Russian science.

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