PERSONALIA

Petr Petrovich Feofilov (on his sixtieth birthday)

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April 13, 1975 was the 60th birthday of the prominent Soviet physical scientist, Corresponding Member of the USSR Academy of Sciences, Doctor of Physico-mathematical Sciences and Professor Petr Petrovich Feofilov.

The basic field of physics to which Feofilov has devoted a major part of his 35-year scientific career is the optics and spectroscopy of the condensed state. His pioneering work in this field has formed a basis for a number of new scientific trends and advanced him into the ranks of world-famous scientists. One of these trends was the polarized luminescence of molecules and crystals. Feofilov's interests were directed into this area under the influence of his teacher S. I. Vavilov, and have stayed there throughout his entire career.

Feofilov's cycle of papers on polarized luminescence began with a study (made jointly with B. Ya. Sveshnikov) of the concentration depolarization of the fluorescence of molecular solutions. This paper established the dependence of the processes that determine the concentration depolarization of fluorescence on the lifetime of the excited state of the molecule. This experimental fact was used by Vavilov as the basis for his development of the theory of luminescence concentration phenomena. The care that Feofilov lavished on this first scientific paper can be appreciated from the fact that the experimental results obtained in it are used even now, more than 30 years later, as a check on the correctness of concentration-effect theories in luminescence.

Feofilov later investigated the polarization spectra of numerous organic compounds and showed that these spectra are an expression of the anisotropy of the molecules and carry important information on their structure. He established the relation between the degree of luminescence polarization and the structural symmetry of the luminescing molecules and developed a method proposed by Vavilov for determination of the multipolarity of the elementary radiators. Feofilov's papers in this area are widely known both in the USSR and abroad. The results that he obtained are cited in all monographs on molecular luminescence, and the polarization method for determination of the structures and, in particular, the symmetries of organic compounds have come into extensive use.

Feofilov was awarded a First Degree D. I. Mendeleev Prize in 1949 in recognition of his cycle of papers on polarized luminescence. These studies were later extended to inorganic single crystals and resulted in the development of new and highly effective methods for study of impurities and defects in crystals. On the basis of his discovery of the polarized luminescence of cubic crystals and its azimuthal dependence, Feofilov formulated the concept of latent optical anisotropy of cubic crystals with impurities and defects. These classical investigations of latent anisotropy have formed the basis of a new and original trend in crystal optics and have strongly influenced the development of crystal research in the Soviet Union and abroad.

Feofilov generalized his studies in this field in the monograph "Polyarizovannaya Lyuminestsentsiya Atomov, Molekul i Kristallov" (Polarized Luminescence of Atoms, Molecules, and Crystals) (1959). It has been translated into English and enjoys wide recognition.

Feofilov participated actively in the USSR's development of techniques for artificial growing of single crystals of optical fluorite and its crystal-chemical analogs (1952–1955). Special mention should be made of the fact that progress in the matter of growing high-quality fluorite crystals has been determined in large part by quick and efficient study of their physical properties with the aid of the methods developed by Feofilov. His papers on the formation of artificial single crystals and investigation of their properties have been of exceptional importance for science and engineering, since they resulted, on the one hand, in significant broadening of our conceptions as to the structure of single crystals with impuri-

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ties and, on the other hand, in the development of valuable new optical materials.

Feofilov's internationally recognized papers on single crystals activated by ions with unfilled shells are especially important. He was one of the first investigators to undertake a systematic study, even during the "prelaser" days, of the optical properties of crystals containing rare-earth ions and uranium. In his pioneering studies of fluorite crystals activated by rare earths, he became the first to state such important problems as those of the multiplicity of the activator centers, the crystal-chemical conditions of activation, and the role of the charge state of the ion. It was largely due to the efforts of Feofilov that the physics of activated crystals was ready to accept the ideas of quantum electronics. It is no accident that the creation of the first "four-level" solid-state lasers on the basis of fluorite with samarium and uranium was based directly on the results of Feofilov's spectroscopic and luminescence research. He made a broad-gauge study of the infrared luminescence of trivalent neodymium—an ion widely used in solid state lasers. With his colleagues, he prepared and studied many new activated crystal systems that are of interest for quantum electronics. His work in the spectroscopy of divalent rare-earth ions in crystals was highly important, establishing the essential role of mixed configurations and the relation of level schemes of f^n configurations of the divalent ions to the schemes of isostructural trivalent ions.

Feofilov's 1956 observation of luminescence in a number of inorganic crystals, which was interpreted as emission of excitons, was of great scientific importance. These studies were subsequently amplified on an exceedingly broad scale.

Feofilov originated the theory of the Zeeman effect in cubic crystals and performed the first experiments in this field. Developing his work on the magnetooptics of activated crystals, Feofilov demonstrated the productivity of applying methods of magnetic circular anisotropy to study allowed interconfigurational transitions in rare-earth ions. The phenomenon of giant spin memory in certain crystals with rare-earth activators was observed in a study of magnetooptical phenomena.

In the course of his studies in the spectroscopy of activated crystals, Feofilov discovered the electron phototransfer effect between activator ions. Expansion of these studies by Feofilov and his co-workers made it possible to propose an ionic type of photochrome medium, e.g., for registration of holographic images.

In recent years, Feofilov's laboratory has been successfully advancing a new and original trend—the investigation of cooperative processes in condensed media. These studies have led to the prediction and discovery of a number of new phenomena, such as cooperative luminescence sensitization, which makes possible the summing of electronic excitations and effective transformation of infrared to visible radiation. "Cooperative" luminophors, combined with gallium arsenide photodiodes, make it possible to create miniature light sources for use in optoelectronic circuits. In addition to their applied importance, cooperative phenomena are of great conceptual value, opening new pathways to understanding of the spectral sensitization mechanisms of various photophysical, photochemical, and photobiological processes. In 1970, Feofilov was awarded the S. I. Vavilov Gold Medal for his work on the spectroscopy and luminescence of activated crystals.

Note should be taken of the breadth of Feofilov's scientific interests. Apart from the spectroscopy of crystals, his work and that of the school that he heads have influenced such divisions of solid-state physics as crystal chemistry and crystal physics, the physics of radiation-induced defects in crystals, and many others.

Jointly with N. A. Tolstoĭ, he completed an extensive cycle of papers on fast processes in luminophors and semiconductors, using a new method for investigation of relaxation processes that has come to be known as the "taumeter" method. This procedure makes possible fast and accurate determination of the radiative-transition probability—a quantity of very great importance for the theory and development of optical-band lasers.

In 1949, a Third Degree USSR State Prize was awarded for the work on development of the method for study of fast physical processes.

Feofilov's role as a scientific organizer cannot be overestimated. The work done in his laboratory has influenced the creation of new research centers in various laboratories around the country. Research in crystal spectroscopy is now underway on a broad front in our country and on a high scientific level. Feofilov has been the initiator and organizer of All-Union Conferences on the spectroscopy of activated crystals, which have been of extremely great importance for the development and coordination of research in this field in the USSR.

Feofilov combines a heavy research workload with many-sided literary activity. He has translated a number of books from the German, English, and French. His editorial activities and his numerous popular-science articles are well known. He has been deputy editor-in-chief of the journal "Optika i Spektroskopiya" since its inception (1956). He is on the editorial Councils of the International Journals "Physica Status Solidi" and "Optics Communications."

Feofilov is a member of the Scientific Councils on Spectroscopy and Solid-State Radiation Physics, and Deputy Chairman of the Scientific Council on Luminescence and its Applications in the National Economy.

Feofilov's great accomplishments in science and his excellent human qualities—straightforwardness, kindness, objectivity, love for work, and great self-discipline—have won him universal respect.

Congratulating Petr Petrovich on his sixtieth birthday, we wish him further creative successes.

Translated by R. W. Bowers