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EVGENIĬ FEDOROVICH GROSS

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1968 marks fifty years of scientific activity of the well known Soviet physicist, a major scientist in the field of spectroscopy of the condensed state, a corresponding member of the USSR Academy of Sciences, Lenin Prize laureate, Professor Evgeniĭ Fedorovich Gross.

Gross is a representative of the brilliant group of Soviet opticists and spectroscopists, who started their scientific activity at the State Optical Institute under the guidance of Dmitriĭ Sergeevich Rozhdestvenskiĭ. Gross arrived in Rozhdestvenskiĭ's laboratory in 1918 as a first-year student of the physical-mathematical department of the Petrograd University. After graduation from the university in 1924, he stayed on to prepare for a scientific and pedagogical career; he simultaneously continued work at the State Optical Institute. The training obtained under Academician Rozhdestvenskii has left an imprint, using Gross' words, on all his scientific creativity.

The first experimental research in which Gross took part was on the hyperfine structure of spectral lines in gases (1926). Very soon, however, he started to concentrate on that field of physics, the spectroscopy of the condensed state, to which he devoted since all his ardent energy and the great research talent, and which amply rewarded him for it. It is now difficult to point to any division of the spectroscopy of liquids, glasses, or crystals, to the development of which Gross did not make an appreciable and sometimes basic contribution.

In the pre-war years Gross completed a brilliant cycle of investigations on the scattering of light in condensed systems. He pioneered in research of Raman scattering of light in crystals, which is of great importance for the understanding of the structure of glasses and of amorphous bodies in general. The experimental discovery, in 1930, of the fine structure of the Rayleigh scattering line in crystals and liquids, due to hypersound waves, was predicted theoretically by L. I. Mandel'shtam and by Brillouin; the entire significance of this discovery became fully manifest recently in connection with the observation of stimulated Mandel' shtam-Brillouin scattering. In 1935 he discovered, jointly with M. F. Vuks, the scattering spectrum at low frequencies in crystals ("Gross frequencies"), connected with the intermolecular vibrations in the lattice, and explained the nature of the "wings" of the Rayleigh line in liquids. Even the list alone of the results, many of which are presently classics, gives an idea of the scale of work Gross performed on the scattering of light. These investigations demonstrated the tremendous potential of research on scattered light for the solution of fundamental problems of the structure and properties of liquids, glasses, and crystals, and exerted a strong influence on the development of molecular optics in the USSR and abroad. They brought Gross world fame in physics and advanced him to the forefront as a leading Soviet spectroscopist.

ЕВГЕНИЙ ФЕДОРОВИЧ
ГРОСС

In 1936 Gross was awarded, without defense of a dissertation, the degree of doctor of physical-mathematical sciences for his work on the scattering of light. In the same year, he was placed in charge of the division of molecular physics of the physics department of the Leningrad university; in 1938 he was appointed professor in charge of the department of molecular physics, which he organized as a university department for the first time in the Soviet Union. During the same time, Gross was busily engaged in organizational activity involved in the creation of the laboratories of the molecular division. From among the investigations of that time, note should be taken of his pioneering work on the connection between light scattering and relaxation phenomena in liquids, and of the method, proposed by him in 1940 for determining the time of orientational

relaxation of molecules from the scatter-light spectrum, a method suitable for nonpolar liquids. Gross was awarded a state prize later for this work.

In 1946, he was elected a corresponding member of the USSR Academy of Sciences.

After the war, he continued to carry out, together with his co-workers, successful research on the Raman scattering of light (study of second-order scattering in crystals, which made it possible to observe spectroscopically the entire elastic spectrum of the lattice; research on the hydrogen bond in crystals and liquids, etc.). However, the center of gravity of Gross' scientific interests lay at that time in the field of electronic spectra of crystals. These investigations were carried out by Gross principally in the Physico-technical Institute of the USSR Academy of Sciences, where he organized in 1944, at the suggestion of Academician A. F. Ioffe, a laboratory for solid-state spectroscopy.

Of outstanding significance was his discovery in 1951 of the hydrogenlike spectrum of the exciton in the absorption of the cuprous oxide crystal. It was the first experimental proof of the existence in semiconductors of excitons, the quasiparticles predicted by Ya. I. Frenkel' in 1931, and served as the starting point for extensive research on the exciton state in solid state physics.

Gross has been engaged since 1951, with his characteristic researcher's temperment, in a systematic study of different properties of excitons, and discovered jointly with his students and co-workers a large number of new phenomena: the Stark effect and ionization of excitons by an electric field, the diamagnetic Zeeman effect in crystals, the diamagnetism of large-radius excitons, the part played by excitons in the formation of the magnetic-absorption oscillation spectrum, magnetooptic and piezospectroscopic phenomena in spectra of quadrupole and indirect exciton transitions, the existence of bound exciton states, the exciton structure of the photoconductivity spectrum in crystals, and radiative anihilation of excitons.

In these investigations, paying particular attention to the fundamental aspect of the problem, Gross attempted to demonstrate experimentally the basic property of excitons - their migration in the crystal. Persistent research in this direction were crowned with success. The exciton energy bands (exciton-photon transitions in cuprous oxide) were observed directly, new effects connected with the presence of a finite exciton wave vector were discovered (the effect of inversion of the magnetic field in the Zeeman spectrum of the exciton, optical anisotropy of cubic crystals), and finally, the Boltzmann velocity distribution of free excitons was investigated (by determining the contour of the exciton lines in cadmium sulfide). Recently Gross has been greatly interested in the participation of exciton states in coherent emission from semiconductors; in recent experiments, performed with his students and L. N. Kurbatov, Gross was able to demonstrate experimentally the existence of such a participation (with cadmiun selenide as an example). The priority and the fundamental significance of Gross' research and that of his school in the field of the exciton are universally recognized in the scientific world. An demonstration of the recognition of his great creative merit in the study of excitons was the fact that he was awarded the Lenin prize in 1966.

The research on excitons in crystals revealed most brightly Gross' main characteristic features as a scientist. His tendency to search and investigate new hitherto unknown phenomena and to study fundamental problems, interest primarily in the fundamental qualitative aspect of the phenomena, and great scientific intuition and boldness in stating and defending the scientific truth. If we add to this the researcher's art, the tendency to organize subtle experiments using extremal experimental conditions, then we obtain a partial answer to the question of the cause of Gross' "success" in physics. To Gross, scientific work is always creativity and the discovery of new things. It is therefore no accident that he is also fond of art - painting and music - and has a deep interest in new trends in art.

Gross' style of scientific work has attracted young people to his laboratory. Many of his students and coworkers became candidates and doctors of sciences and are successfully performing independent research.

Gross' creative potential and the enthusiasm of scientist are undiminishing. He continues to expand his research on the optical properties of crystals, attracting young scientists to this problem and organizing and directing new experiments.

He is now organizing a new laboratory with new research trends at the institute of semiconductors of the USSR Academy of sciences.