Antonina Fedorovna Prikhot'ko

(To the centenary of her birthday)

(1906–1995)

The issue in your hands (Low-Temperature Spectroscopy and Optics) is dedicated to the memory of Antonina Fedorovna Prikhot'ko, whose centenary is celebrated by scientific community in 2006. Everyone who knew and remember her has remained in the memory this handsome and active woman and highly educated and wise person. But this is not so essential. The main thing is that she was an outstanding scientist, a prominent organizer, and the founder and the head of the internationally known spectoscopic school of experimentalists.

A.F. Prikhot'ko was born on April 26, 1906 in Pyatigorsk. She graduated from a high school in Kislovodsk, and decided to go on with her education in Leningrad (Sankt Petersburg), where she entered the Department of Physics and Mathematics at the Polytechnical Institute. Undoubtedly, she was lucky because the lectures were given there by A.F. Ioffe, S.Ya. Frenkel, the future Nobel Prize winner N.N. Semenov, and D.V. Skobeltsin. Just at that time she started to work under supervision of the famous scientist Prof. I.V. Obreimov with whom she, being a student, made her first research work. It was I.V. Obreimov who invited her in 1930 to Kharkov, the capital of Ukraine at that time, where he was appointed to a post of the director of the Ukrainian Physico-Technical Institute established in 1929. In the 30s it was at that Institute that such outstanding physicists of the XX century as L.D. Landau and L.V. Shubnikov worked, the first in the former USSR cryogenic laboratory was created, and the low-temperature optics of molecules and crystals became one of the leading lines of research.

In the 40s A.F. Prikhot'ko measured low-temperature spectra of a great number of organic and inorganic crystals. She also took interest in solid oxygen and started to study its extraordinary bimolecular absorption the nature of which had remained unknown for many decades.

In 1943, during the Second World War, A.F. Prikhot'ko defended her thesis for a Doctor's degree and became Doctor in Physics and Mathematics, the first woman — Doctor in the USSR. It should be noted that although, later on she was elected a Full Member of National Academy of Sciences (NAS) of Ukraine, she had still remained the only of the physicists woman of this status.

After the War A.F. Prikhot'ko left for Kiev to the Institute of Physics of NAS of Ukraine, where she worked for half a century. At that Institute she proceeded with her work and brought up a pleiad of the brilliant physicists-experimentalists among which were M.T. Shpak, V.L. Broude, M.S. Brodin, V.V. Eremenko, C.M. Ryabchenko, M.S. Soskin, I.Ya. Fugol' and many others.

As for A.F. Prikhot'ko's achievements in science, we think that the main result that brought fame to her was the discovery of the collective excitonic nature of the excited electronic states in molecular crystals. The states of small radius in nonmetallic crystals were first considered by the prominent theorist Ya.I. Frenkel. These states were called Frenkel excitons the discovery of which as a new type of quasi-particles had been made just by A.F. Prikhot'ko. In fact, she was the first to observe and to prove experimentally the existence of polarized doublets in molecular crystals with several (in particular,

two) molecules in a unit cell. The principal moment was a reliable verification of the doublets occurrence in those cases where the electronic term of molecules proved to be a nondegenerate one. That was also done by A.F. Prikhot'ko. Later on, these doublets were called Davydov's ones in honour of A.S. Davydov, the author of the consistent theory of molecular excitons.

The pioneer studies of A.F. Prikhot'ko and her disciples were internationally highly appreciated and the physics of molecular excitons became an independent and universally recognized direction in solid state physics. For her discovery and investigation of excitonic states in crystals A.F. Prikhot'ko was given in 1966 science award — Lenin Prize, and in 1976 she received the highest (in the USSR) State award — Hero of Socialist Labour Gold Star. Note that by that time the exciton research were conducted almost in every country but A.F. Prikhot'ko was their recognized leader.

Beginning with the 70s she returned to bimolecular spectra of solid oxygen, which she managed to study at $T \approx 1$ K, and unexpectedly revealed that all the lines of its low-temperature α-phase were doublets despite the fact that the Davydov splitting in it is impossible. The theorists enlisted to explain that phenomenon obtained another unexpected result: the Davydov splitting is really impossible for the region of single-molecular absorption. As for the bimolecular one, it is necessarily doublet if the absorption lines correspond biexcitons (coupled states of Frenkel excitons) and, what is more important, the doublet lines are polarized! To test the theory required a single crystal of α-oxygen, that could not have been grown so far anyone despite all efforts. Having looked thoroughly into the reason of failures with coworkers L.I. Shanski and Yu.G. Picus, A.F. Prikhot'ko solved this very difficult a methodical problem, and after many attempts the oxygen single crystals were grown. The ensuing experiments provided support for the theory. So we can state that the comprehensive study and proof of the collective behavior of states (electronic, vibronic) in molecular condensed systems (polymers and biomolecules included) belong by right to A.F. Prikhot'ko and her school.

But not only this. Without overestimation, it must be acknowledged that A.F. Prikhot'ko is the author of one more discovery: somewhere in middle of the 70s she discovered cryocrystals, not as the large family of solids, but as a new physical concept which replaced the term «solidified gases» used for many years, and which she did not like because of its inherent inconsistency. The physical community approved the new term at once, and it became popular.

Antonina Fedorovna Prikhot'ko had lived long and rich in events life. She had succeeded in many things. In particular, her support had favoured the development of such modern directions as laser physics, holography, optics of nanomaterials and liquid crystal systems, cryocrystal physics, high-temperature superconductivity, in searches of which were intensively involved her coworkers and in which she belived long before the discovery of copper oxides.

The papers dedicated to memory A.F. Prikhot'ko and published in this issue of «Fizika Nizkikh Temperatur» reflect adequately her own interests and the directions promoted by her as well those had recently appeared in the frame of condensed matter physics.

The contributions cover experimental and theoretical investigations of quantum and classical solids as well as clusters and nanoobjects. The review by Moroshkin et al. surveys the studies of defects in solid ^{4}He which were performed employing a number of optical spectroscopy methods. Lattice distortion of solid He under pressure is considered theoretically by Tretyak et al. with the focus on many-body forces. The paper by Kolmakov et al. deals with generation and propagation of nonlinear and shock sound waves in the superfluid phase of ^{4}He.

The high-pressure crystalline phases of classical cryocrystals (CO_2) were studied using the infrared absorption spectroscopy by Giordano et al. The authors present the first data on phases II and IV. Extraordinary behavior of the isochoric thermal conductivity of solid CO_2 doped with rare-gas atoms was found and explained by Konstantinov et al. The paper by Minenko and Jodl presents interesting results on the N_2–O_2 binary system probed by the infrared absorption spectroscopy. The effect of oxygen admixture on relaxation processes in pre-irradiated Ar cryocrystals is discussed by Savchenko et al. The paper by Jezowski et al. deals with magnetic susceptibility of O_2 cryocrystals.

Interesting aspects of spectro-temporal holography and hole-burning studies in molecular doped solids are reviewed by Galaup. The hole-burning spectroscopy employed by Somoza and Friedrich enabled the authors to study in detail quantum effect which consists in rotation tunneling of methyl groups. Important spectroscopic data on crystalline ortho-bromobenzophenone are presented in the paper by Avdeenko et al. The paper by Ostapenko et al. is concerned with the spectroscopy of nanosized silicon-organic polymers incorporated into porous silica materials. The data on structure and photo-induced reactivity of malonaldehyde and acetylacetone in N_2 matrices are presented by Trivella et al. The contributions by Kanaev et al., Tachibana et al. and Gilb et al. focus on clusters properties with the accent on size effects. The theory of exciton condensation in quantum wells is presented by Sugakov. The contribution by Gaididei and Loktev presents the idea concerning an increase of the critical temperature of superconducting transition in multiwall nanotubes.

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