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**VADYM YEVHENOVYCH LASHKARYOV,
THE OUTSTANDING UKRAINIAN PHYSICIST
OF THE 20th CENTURY, THE DISCOVERER
OF THE *p-n* JUNCTION IN SEMICONDUCTORS
(dedicated to the 120th anniversary of his birthday)**

*The life and the scientific career of V. Ye. Lashkaryov – an outstanding Ukrainian scientist of the 20th century and the founder of the Institute of Semiconductor Physics of the National Academy of Sciences of Ukraine – are described. In 1941, he published the first article in the world literature devoted to the *p-n* junction in Cu_2O . The consideration is mainly focused on the specific features of his research manner, his role in the education and training of a new generation of Ukrainian physicists, and on his personality as a scientist.*

Keywords: V. Ye. Lashkaryov, semiconductors, *p-n* junction, contact, surface.

October 7, 2023 marked the 120th birthday of an outstanding Ukrainian physicist and an organizer of science and education in Ukraine Vadym Yevhenovych Lashkaryov (1903–1974). His disciple and one of the pioneers of surface physics V.G. Lytovchenko has called the scientist (together with O.G. Goldman, P.G. Borzyak, and V.I. Lyashenko) “one of the founders of physical science in Ukraine” in the years before World War II [1]. The following clarification has to be made. At that time, many famous high-

rank Ukrainian physicists were working mainly in Kharkiv. But namely due to these above-mentioned scientists together with their colleagues and disciples, Kyiv began to transform into a significant European physical center.

V. Ye. Lashkaryov occupies a special place among them. Actually, he became a person who formed the semiconductor science in Ukraine and determined the scope of its research priorities for decades ahead (all notable physicists who worked in Ukraine in the middle of the last century in this field of science either belonged to his circle or were his disciples). He is a discoverer of the *p-n* junction (in 1941). This is a result that stands very close to the Nobel-prize level, because the matter concerns a physical object that underlies the operation of almost all micro- and nanoelectronic devices.

V. Ye. Lashkaryov was the first to organize the semiconductor physics specialization at Kyiv Uni-

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Fig. 1. V.Ye. Lashkaryov, Academician of the Academy of Sciences of the Ukrainian SSR and the discoverer of p - n junction in semiconductors

versity (in 1949) and, later (in 1952), the Chair of Semiconductor Physics, which he headed during the first four years of its work. He initiated the creation of the Institute of Semiconductor Physics (ISP) of the Academy of Sciences of the Ukrainian SSR (in 1960) and was its first Director for a decade. He was one of the creators of *Ukrains'kyi Fizychnyi Zhurnal* (*Ukrainian Journal of Physics*) in 1956 and worked there as its Editor-in-Chief for 16 years. From the above, it is clear why the person of V.Ye. Lashkaryov still attracts the attention of physicists of every new generation. Today, one can learn a lot about the role of the scientist in the creation and foundation of the ISP from monograph [2].

The role of V.Ye. Lashkaryov in the discovery of a p - n junction was analyzed in works [3–6]. Among them, publication [4] deserves a special attention, because it was exactly after its appearance that the scientist was eventually mentioned in the article about the p - n junction in the English-language Wikipedia. A valuable analysis [7] was published recently in connection with the birth anniversary of the scientist, where not only a general overview of V.Ye. Lashkaryov's contribution to the semiconductor science and technology was given, but a lot of little-known facts

from his life were presented, which were established on the basis of archival sources, and a scientometric analysis of his heritage (which keeps being referred to) was performed for the first time.

Especially valuable are the memoirs of those who closely communicated with V.Ye. Lashkaryov. This is his student of the Arkhangelsk-exile period; later, this is a prominent surgeon, writer, and public figure M.M. Amosov [8], as well as his students V.G. Lytovchenko [9] and V.I. Strikha [10], who later became his post-graduate students and for whom V.Ye. Lashkaryov determined the main directions of their later scientific interests, surface physics and metal-semiconductor contact physics, where they have already created their recognized scientific schools. Those memories allow V.Ye. Lashkaryov to be considered not only as an outstanding scientist and a science manager, but also as a very peculiar and nice living person. This is especially valuable now, when the number of people who personally knew V.Ye. Lashkaryov unfortunately diminishes every year.

The availability of the mentioned literature frees the author from the necessity to expound the biography of V.Ye. Lashkaryov in detail and, instead, allows only its general aspects to be described.

The scientist was born on October 7, 1903 in Kyiv. His father belonged to the noble estate. He was a lawyer and, in the pre-revolutionary years, a deputy (a comrade in terms of that time) of prosecutor. Therefore, the young Vadim Lashkaryov had to hide his “hostile social background”. In 1920, he graduated from the First Kyiv Gymnasium and, in 1924, from the Kyiv Institute of People's Education (the University of Kyiv title at those days). In 1924–1927, he was a post-graduate student and a lecturer at the Kyiv Scientific and Research Department of Physics founded by O.G. Goldman at the Kyiv Polytechnic Institute. In 1929, the department was transformed into the Scientific and Research Institute of Physics (now the Institute of Physics of the National Academy of Sciences of Ukraine (NASU)). But V.Ye. Lashkaryov came to work here again only after 10 years, after the Leningrad and Arkhangelsk periods of his biography.

The thing was that the young and promising Kyivan attracted the attention of the “father of Soviet semiconductor physics”, the student of W.C. Roentgen, academician of the Academy of Sciences of the

USSR, the foreign member of the Shevchenko Scientific Society in Lviv A.F. Ioffe, who was born in the town of Romny. That is why V.Ye. Lashkaryov went to work at the Leningrad Physical and Technical Institute headed by Ioffe. Since 1930, he headed the Department of X-ray and Electron Optics and, since 1933, the Laboratory of Electron Diffraction.

The first articles of the young scientist were published in 1926: on the theory of gravitation [11] (in German; a decade had passed since the creation of the general theory of relativity, and this was a serious interest of V.Ye. Lashkaryov) and on radiography issues [12] (in Ukrainian; this paper opened the very first issue of *Ukrainski Fizychni Zapysky* (*Ukrainian Physical Notes*), a new journal created by O.G. Goldman). Another article devoted to the temperature effect on the diffraction of slow electrons was published in English in the most influential scientific journal *Nature* [13] in 1934. (It is of interest that this article was not mentioned in the Soviet sources dedicated to V.Ye. Lashkaryov, and it was “rediscovered” only by the authors of paper [7] when working with the scientist’s profile in Web of Science.) A year earlier, the single-authored monograph *Electron Diffraction* was published in Russian [14].

At the beginning of 1935, on the basis of the results of his research, V.Ye. Lashkaryov was awarded the degree of Doctor of Science in physics and mathematics (as has been emphasized in various sources for a long time, it occurred without defending a dissertation). Only the authors of work [7], by analyzing the relevant documents, revealed that the public defense of the thesis “Diffraction of slow electrons” did take place, but this fact was suppressed, probably because of the arrest of the scientist shortly afterward. Furthermore, the scientist was invited to report those results at a meeting of the Faraday Society in London. The trip did not take place for obvious reasons. Nevertheless, a large V.Ye. Lashkaryov’s article appeared in *The Transactions of the Faraday Society* [15].

In February 1935, the scientist was arrested for “the participation in a counter-revolutionary group of a mystical sense”. This was a result of his dangerous (under the conditions of the totalitarian USSR) strangeness: interest in occultism and visits to a theological circle. Therefore, in July of the same year, V.Ye. Lashkaryov was sentenced to the five-years’ exile in Arkhangelsk (he was rehabilitated only on July

15, 1957). To some extent, the scientist was lucky: if he had been arrested two years later, in the macabre 1937, he would most probably have been shot. This exile only resulted in a break in his rapid scientific career growth: in 1935–1939, V.Ye. Lashkaryov headed the Physics department of the Arkhangelsk Medical Institute, where he lectured to a student Mykola Amosov and, at the same time, tried to deal with biophysical problems, as far as it was possible in a provincial university with its limited experimental base.

In 1939, on the wave of the short “Beria thaw”, which occurred after the greatest horrors of the “Yezhov Terror” V.Ye. Lashkaryov returned to Kyiv. The Director of the Institute of Physics O.G. Goldman, a Jew by nationality and a Lutheran by religion, had already been arrested at that time for the “Ukrainian bourgeois nationalism” as “Mykola Skrypnyk’s accomplice” and deleted from the list of academicians. The work of the Institute of Physics was estimated as “worthless” and defamed by a commission headed by A.F. Ioffe himself, who did not have the civil courage to refuse the role imposed on him. The institute was temporarily headed by the Komsomol and party leader O.G. Miselyuk whose testimony formed a basis for the indictment of O.G. Goldman (see [16] for details). So, the institute needed a strengthening, and V.Ye. Lashkaryov got the position of the Head of the Department of Semiconductors at the Institute of Physics of the Academy of Sciences of the Ukrainian SSR.

Actually, it was O.G. Goldman who managed in his works to lay the foundations for V.Ye. Lashkaryov’s greatest discovery, the p - n junction. When studying the investigation case, the authors of work [16] revealed that as long ago as in 1937, at a seminar of the Institute of Physics, O.G. Goldman made a report on the principles of the metal-semiconductor contact operation, i.e., a year before the classical works by Walter Schottky [17] and Neville Mott [18]. But the arrest of the scientist made the publication of this result impossible. Nevertheless, the most important work of V.Ye. Lashkaryov [19] arose precisely on this ground.

Till now, this work impresses with its elegance, transparency, and persuasiveness. While studying Cu_2O crystals (the “most popular” semiconductor at that time), an original thermoprobe with two closely spaced electrodes was applied, with one of the lat-

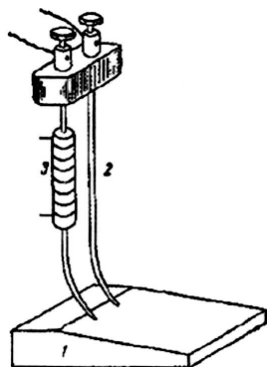


Fig. 2. Experimental device for studying photocells based on Cu_2O etched to a wedge-shaped form: photocell (1), thermoprobe (2), oven – stove (from work [19]) (3)

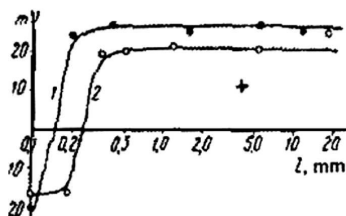


Fig. 3. Thermo-emf value as a function of the thermoprobe distance from the wedge edge for two differently prepared cuprous oxide crystals 1 and 2 (from work [19])

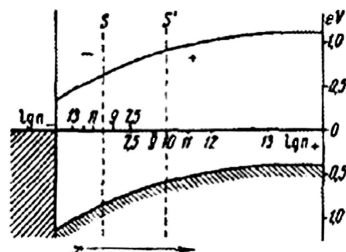


Fig. 4. Energy band structure of a rectifier based on a Cu_2O crystal with the p - n junction (from work [19]). The p -conductivity region is located to the right from the vertical line S' , and the n -conductivity one to the left from the vertical line S . The numbers below and above the abscissa axis denote the logarithms of the hole, n_+ , and electron, n_- , concentrations

ter being heated by an oven (see Fig. 2). A wedge-shaped specimen was required in order to measure the conductivity at various depths below the surface of a bulk crystal. Using the device depicted in Fig. 2, the thermo-emf was found as a function of the distance between the thermoprobe and the wedge edge (see Fig. 3). Those dependences demonstrated a change of the thermo-emf sign from “minus” near the wedge

edge (i.e., near the surface of the copper oxide specimen) to “plus” farther from the edge (i.e., in the specimen depth).

In the same paper, V.Ye. Lashkaryov derived formulas for the electron and hole concentrations depending on the Fermi level location in the forbidden gap. Today, those formulas can be found in textbooks. However, at that time, it was an important and independently obtained result (although it was obtained independently and almost simultaneously by several different authors). By plotting the corresponding dependences, as a result, V.Ye. Lashkaryov reconstructed the band structure of the first p - n junction studied in mankind history, which is a current rectifier (Fig. 4).

Unfortunately, this absolutely clear and convincing work was not noticed and appreciated properly. For some reasons (among the main ones, it was an obvious underdevelopment of semiconductor technologies at that time), it remained practically unknown in the West, where Russell Shoemaker Ohl (1898–1987) has been conventionally considered as a discoverer of the p - n junction [20]. However, Ohl’s application for a patent [21], which is considered as the evidence of his priority, was made on May 27, 1941 (i.e., after V.Ye. Lashkaryov’s work had been published), and the patent itself was issued only on June 25, 1946. It should also be noted that the first articles devoted to p - n junctions in germanium and lead sulfide were published in Western journals only in 1947 (a review of those articles can be found in the classical work by W. Shockley [22]). Therefore, although R.S. Ohl also worked independently in the same direction, the priority of V.Ye. Lashkaryov in the discovery of the p - n junction is undoubted.

After the analysis [4] was published, work [19] began to be mentioned in the Western sources as well. In particular, in paper [23], V.Ye. Lashkaryov’s article was mentioned among the fundamental works that led to the electronic information revolution in the 20th century. The statement about V.Ye. Lashkaryov’s priority, which, at the beginning of the 21st century, could only be read on the pages of *Visnyk NAN Ukrainy (Bulletin of the NAS of Ukraine)* [3], finally appeared on the pages of leading international journals. Of course, this event was facilitated by the appearance of the English translation of work [19] in the open access in the special jubilee issue of *Ukrainian Journal of Physics* which contains 35

of the most significant works of Ukrainian physicists performed after the creation of the Academy of Sciences of Ukraine in 1918.

It is important to point out that V.Ye. Lashkaryov's discovery was very quickly implemented in practice. After the German-Soviet war started, the scientist was evacuated to Ufa. There, at the local military plant, together with the young Doctor of Science S.I. Pekar, he organized the production of reliable solid-state copper-oxide-based diodes, which found application in the military UHF equipment, in particular, in portable radio stations (see Fig. 5). This made it possible to abandon the application of cumbersome and unreliable electron tubes, which, in addition, required a significant power supply [7]. For this activity, the scientist was awarded the Badge of Honor order (in 1944) and, despite his "hostile" class origin and Northern exile, elected an Academician of the Academy of Sciences of the Ukrainian SSR (in 1945).

In 1944–1952, after returning from Ufa to Kyiv, V.Ye. Lashkaryov simultaneously worked at the Institute of Physics of the Academy of Sciences of the Ukrainian SSR and headed the Physics Chair (and in 1952–1956 the newly created Chair of Semiconductor Physics) at the Kyiv State University (KSU). On his initiative, the semiconductor specialization was opened at the KSU in 1949; in 1952, the Chair had four lecturers; already in 1956, their number increased significantly (see Fig. 6).

In those years, surface physics attracted the more and more attention of the scientist. M.G. Nakhodkin, one of V.Ye. Lashkaryov's colleagues at the Radiophysics Faculty of the KSU and, in the future, Academician of the National Academy of Sciences of Ukraine noted, "*In those distant times, the choice of such a research direction was revolutionary, because most researchers believed that the properties of semiconductor devices mainly depend on their bulk characteristics. Only many years later, special attention was paid to an extremely important role of the semiconductor surface physics, because it turned out that the majority of existing semiconductor devices use the properties of heterojunctions, the creation and research of which was awarded Nobel Prizes and still has not lost its relevance, because those results are applied in modern nanoelectronics*" [24].

Among V.Ye. Lashkaryov's works of that time, a special place is occupied by a review article written

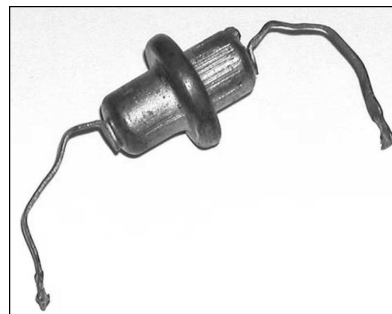


Fig. 5. Copper-oxide p - n diode. Manufactured under Lashkarev's supervision by Ufa munitions factory in 1941–1945, was used in military wireless sets (from the site http://icfst.kiev.ua/MUSEUM/PHOTOS/Lash-Diod_u.html)

together with V.I. Lyashenko, which was published in the prestigious jubilee collection of works dedicated to the 70th anniversary of Academician A.F. Ioffe in 1950 [25]. In this paper, in particular, the results of the studies that revealed the screening of an external field and the dipole field of adsorbed molecules by charged surface centers were summarized. This article appeared three years before the classical work of J. Bardin and W. Brattain [26] was published; unfortunately, it also remained almost unnoticed in the West, because the "iron curtain" was drawn in those years between the democratic world and the totalitarian USSR.

In the mid-1950s, V.Ye. Lashkaryov started a series of works on the topic "Research on the surface physics of semiconductor microwave detectors" in the Special laboratory of ultra-high frequencies at Kyiv University, which was headed by him. In the laboratory, the photoconductivity and photo-emf of the valve and non-valve (bipolar-diffusion) origins, as well as the influence of contact fields in metal-semiconductor structures were studied. By work [27], he gave a start in life to his two talented post-graduate students who later left a noticeable mark in the development of semiconductor science, V.G. Lytovchenko and V.I. Strikha.

Soon, V.Ye. Lashkaryov determined the specialization of both mentioned post-graduate students for many years ahead. Later, V.G. Lytovchenko recalled that when they were still working at the Special Laboratory, "*I was assigned to a research area dealing with the physical properties of the semiconductor materials (at that time, germanium and silicon) from which the laboratory produced microwave Schottky point diodes, and he was assigned to study the parameters of these*



Fig. 6. Administration and employees of the Chair of Semiconductor Physics (1956). Sitting in the first row (from left to right): N.Ya. Karkhanina, V.I. Lyashenko, V.Ye. Lashkaryov, Yu.I. Karkhanin, H.A. Kholodar, and Yu.I. Grytsenko. Standing in the second row (from left to right): I.G. Sambur, V. Zhytkov, G.P. Peka, V.I. Strikha, and R.M. Bondarenko. Standing in the third row (from left to right): Ye.M. Berezhnyakovskiy, V.Ye. Kozhevyn, and G.P. Zubrin. Heads of the Chair: Acad. V.Ye. Lashkaryov (1952–1956), Prof. V.I. Lyashenko (1957–1960), Prof. Yu.I. Karkhanin (1960–1975), and Prof. V.I. Strikha (1975–1996)

newly created instrumental microwave structures. We immediately found a way to combine our investigations: I began to study surface states at original structures, and Vitalii Ilarionovych the influence of those states and the state of the surface (via the influence of the surface dielectric layer) on the parameters of microwave structures. That was how we, together with V.Ye. Lashkaryov, prepared and published our first – and, as it turned out later, momentous for us – publications” [28].

In 1956, V.Ye. Lashkaryov transferred the management of the university chair to his colleague V.I. Lyashenko, because he undertook new responsibilities: on his initiative, the journal *Ukrainian Physical Notes*, whose publication was stopped during the German-Soviet war, was revived under the title *Ukrainian Journal of Physics (UJP)*. It is of interest that, in the early years of this journal, Ukrainian was its exclusive publication language. In this form (with extended English-language abstracts up to a page), it was issued till 1964, when – “at the demand of time” – there appeared a parallel Russian version. The Ukrainian version was eliminated – “for its needlessness” – at the end of 1976, already under a new editor-in-chief A.A. Smirnov. The journal rating

began to decrease, so the leading physicists in Kyiv and Kharkiv began to send their papers more readily to “all-Union issues”. Nevertheless, in the 1960s, the *UJP* reputation was very high, and this was to a considerable extent due to the Editor-in-Chief of the journal V.Ye. Lashkaryov and the scientific secretary V.I. Sheka.

In 1960, due to the rapidly growing interest in semiconductor science throughout the world, V.Ye. Lashkaryov initiated the creation of the ISP of the Academy of Sciences of the Ukrainian SSR and was elected its Director [7]. The basis of the new institution was composed of the employees from the Institute of Physics: V.Ye. Lashkaryov himself, the prominent theoretician S.I. Pekar, as well as E.Y. Rashba, V.I. Lyashenko, M.F. Deigen, G.A. Fedorus, I.D. Rogovyi, O.G. Miselyuk, R.L. Tomashevskaya, V.Ye. Prymachenko, V.Yu. Kosenko, I.B. Mizetska, N.B. Lukanchykova, L.I. Datsenko, and other scientists. It is of interest that when preparing the creation of the new institute, V.Ye. Lashkaryov offered a job in it to the 76-year-old O.G. Goldman deprived of all his titles and ranks, who returned to Kyiv after a many-years’ exile [16]. But the latter refused the proposition. Perhaps, he did not want to work at the same

institution with those people who had played a sad role in his arrest in 1938...

The scientific and scientific-managerial activity of V.Ye. Lashkaryov during the decade, when he headed the ISP, was described in detail in book [2]. The range of the spectrum of his scientific interests is impressive. Later, V.Ye. Lashkaryov's student V.I. Strikha has formulated the following three main directions to the development of which his teacher made a significant contribution [10]: 1) photoelectric phenomena, 2) surface phenomena, and 3) contact phenomena in semiconductors.

As was already emphasized, V.Ye. Lashkaryov experimentally discovered (using the thermoprobe method) the existence of p - n junction in copper oxide rectifiers. But this discovery by no means exhausts the list of his scientific results. He developed the theory of non-valve photo-emf, introduced the exciton photoexcitation mechanism, developed the theory of condenser photo-emf, experimentally discovered an effect that allows the diffusion displacement length to be controlled by the electric field, began to study surface phenomena (in particular, the relation between the work function and the surface conductivity) and contact phenomena. A more complete list of scientist's achievements can be found in work [7].

By considering V.Ye. Lashkaryov's scientific school, V.G. Lytovchenko proposed to classify its "members" into, on the one hand, V.Ye. Lashkaryov's colleagues and collaborators and, on the other hand, his disciples [6]. According to this classification, the former group included V.I. Lyashenko (he headed the direction of semiconductor surface physics), G.A. Fedorus (photoelectric devices), O.G. Miselyuk (bulk properties of semiconductors), I.B. Mizetska (semiconductor chemistry), Yu.I. Karkhanin (later, the dean of the Faculty of Radiophysics of the KSU, where V.Ye. Lashkaryov headed the Chair), S.V. Svechnikov (optoelectronics), and M.P. Lysytsia (semiconductor optics).

Among the immediate students of V.Ye. Lashkaryov, according to V.G. Lytovchenko, there were P.I. Baranskyi, M.K. Sheinkman, Ye.A. Salkov, V.O. Romanov, O.V. Snitko, and V.G. Lytovchenko himself (all of them developed as scientists already at the ISP), as well as V.I. Strikha, V.A. Brodovyi, and V.M. Dobrovolskyi, who passed the formation stage and realized themselves at the Chair of Semiconductor Physics of the KSU. This list should be appended by O.O. Ptashchenko (chronologically, he became the



Fig. 7. Photoconductivity Department of the Institute of Semiconductor Physics of the Academy of Sciences of the Ukrainian SSR. From left to right: M.K. Sheinkman, Ye.A. Salkov, V.Ye. Lashkaryov, and V.O. Romanov (the beginning of the 1960s) [2]

last post-graduate student who defended his PhD thesis under the supervision of V.Ye. Lashkaryov; later, he worked for many years as a professor at the Ilya Mechnikov University of Odesa).

The list of scientific works of V.Ye. Lashkaryov includes 135 items, including 6 monographs. Today, this figure is not impressive. But in the days when scientometrics had not been invented yet, the slogan "Publish or perish!" did not work, and scientists preferred to write thorough and detailed articles, it looked very dignified. As the analysis of the scientist's profile in the Web of Science database showed [7], his articles are still referred till now (his 40 indexed articles have 361 references; V.Ye. Lashkaryov's Hirsch index equals 8, which is not worse than those of some active members of the Department of Physics and Astronomy of the National Academy of Sciences). Surely, the life of the scientist behind the Iron Curtain and the possibility of publishing almost exclusively in Russian-language issues of the USSR in the post-war period led to the fact that his articles – for example, works [19, 25], whose level and importance were not inferior to, but were published much earlier (!) than similar classical works [22, 26] by J. Bardin, W. Brattain, and V. Shockley, the laureates of the 1956 Nobel Prize in Physics awarded for the creation of a bipolar transistor with two p - n junctions – did not obtain the well-deserved recognition in the world.

This situation was “favored” by the fact that, despite the recognition of his scientific merits and because of the peculiarities of his biography, V. Ye. Lashkaryov was considered “unreliable” in the USSR till his last days and, therefore, he was also not allowed to travel abroad [6]. Only once in his life, he was allowed to visit the satellite Bulgaria, but under special supervision. As a result, he was also deprived of the live communication with Western colleagues at conferences.

Perhaps, the attentive attitude of the “authorities” to the scientist in the 1960s was additionally associated with the fact that, in the 1960s, the ISP became a noticeable center of dissidence. I. G. Zaslavska, an active participant in the dissident movement and the wife of Yu. V. Tsekhmistrenko, worked at the institute till July 1968 [29]. It was I. G. Zaslavska who had agitated some employees of the ISP to sign a letter to the leadership of the USSR with a protest against the return of political repressions (the so-called “Letter by 139” according to the number of signatures). The letter was written in the spring of the same year and, generally speaking, in the very careful wording, with references to the “standards of Lenin’s legality”. The list of “signatories”, after the famous film director S. Parajanov, along with other figures of literature, art, and science, students and workers, also included the ISP employees I. P. Zhadko, Z. S. Gribnikov, B. D. Shanina, M. M. Grigoriev, V. A. Tyagai, V. O. Zuyev, D. I. Abakarov, and V. I. Sheka (the letter’s text and the full list of signatories can be found in work [30]).

It is known that, for many “signatories”, his/her signature was equivalent to the loss of the career and the job. At most institutes of the Academy of Sciences of the Ukrainian SSR, they had a simple choice: to be dismissed either “at will” or “under a criminal article” (the latter meant a “wolf ticket” for the rest of life). According to the laws of those days, it was impossible to remove one of the letter’s initiators, I. G. Zaslavska, who personally drove it to Moscow, from the blow, and she was fired at the insistence of the KGB [29]. Instead, the institute administration managed to save everyone else: they passed only a formal repentance procedure at a party committee sitting. Back in the early 1980s, when the author of this article came to work at the institute, there were rumors among the senior colleagues that M. M. Grigoriev managed to transform this procedure into a

Švejk-like event by loudly proclaiming, “Comrades, I have committed a politically semiliterate crime!” He did it with impunity, too.

However, it is obvious that such an “excessive liberalism” also resulted in that, in 1970, V. Ye. Lashkaryov “was retired” from the Director position. The scientist died on December 1, 1974 and was buried under a modest tombstone at the Baikove cemetery.

It remains to tell about V. Ye. Lashkaryov as a person. Both the comments of his colleagues and the memories of his students invariably emphasize his high intelligence and benevolence, openness to people, and attention to their ideas and achievements. M. M. Amosov recalled a story [8] that Professor V. Ye. Lashkaryov gave him, a student of the Arkhangelsk Medical Institute, an excellent mark for the physics course after listening to his project of artificial heart (completely impossible, as the “inventor” later confessed himself). V. G. Lytovchenko recalls [9] how skilfully V. Ye. Lashkaryov could encourage students of the Chair of Semiconductor Physics of the KSU to scientific work, and how he trained them to review scientific journals by personally selecting the interesting articles for this purpose.

V. G. Lytovchenko’s fellow student, V. I. Strikha, shares the following observations in the text that is a synopsis of his lecture about V. Ye. Lashkaryov given in 1994, i. e., two decades after the death of his teacher [10]: “*Lashkaryov was a human being. It was very interesting to communicate with him. He loved life in all its manifestations. He was interested in various aspects of life. He was fond of occult sciences (for this, he was exiled to Arkhangelsk). He was attentive to ideas (an episode with an evening visit to me, a diploma student). He was able to put anybody in his place (he made me tell him the first 30 elements of Mendeleev’s table). He treated the success of other people with great respect (he refused to be regarded as the supervisor of my PhD thesis)*”.

These short notes need some explanation today. Indeed, the lifestyle of V. Ye. Lashkaryov as a team leader differed very much from that adopted in the USSR. Even today, you can hear a story that he could easily treat a post-graduate student whom he met for the first time and who came to make a report at the institute seminar, with cognac from a bottle taken from the director’s desk. He was really interested in spiritualism (however, Isaac Newton was also seriously interested in alchemy; he commented

on the *Apocalypse*, but did not cease to be a great physicist).

He was incredibly attentive to all ideas of his students. At the same time, he could remind about the distance between the student and the teacher, even via extemporaneously testing the knowledge of the periodic table of elements. He was scrupulously decent in the matters, as they would now say, of “academic integrity” (when having decided that V.I. Strikha did his PhD dissertation completely independently, he refused to be indicated as its formal supervisor; nevertheless, he was present at a modest banquet on the occasion of dissertation defense). All those features together make the figure of V.Ye. Lashkaryov extremely nice; even for those who could no longer communicate with himself.

The memory of the scientist was worthily immortalized. In 2000, the National Academy of Sciences of Ukraine established the V.Ye. Lashkaryov Prize awarded for outstanding works in semiconductor physics and semiconductor device engineering. In 2002, the ISP created by V.Ye. Lashkaryov was named after him. Unfortunately, the masterpiece of the scientist still remains underestimated on a global scale. However, it is encouraging that, due to the efforts of his students and the students of his students, the role of V.Ye. Lashkaryov in the discovery of p - n junction, the basic element of micro- and nanoelectronics, is no longer called into question.

Certainly, the most durable monument to the scientist will be the further successful work of the ISP created by him, the preparation of high-quality “semiconductor” specialists meeting all modern requirements at the Taras Shevchenko National University of Kyiv, and the revival of the Ukrainian semiconductor industry for which the ISP and the University have always been the suppliers of personnel, ideas, and solutions.

To summarize, the author thanks those who provided him the main information about the hero of this article: my mother Naiya Maksimivna Hula, a still active biochemist whose parents had been friends with the Lashkaryov family since the evacuation years, and my late father Vitaliy Ilarionovych Strikha, V.Ye. Lashkaryov’s student, who determined my life choice in favor of semiconductor physics. I must confess: their marriage in 1958 might not have happened without Academician Lashkaryov’s “blessing”. At that time, my grandfather Maksym Fedo-

tovyh Hulyi, biochemist, the then vice-president of the Academy of Sciences of the Ukrainian SSR, when having learned that his daughter, who was brought up under strict discipline, began to meet with a young graduate student-physicist, talked with his scientific supervisor and calmed down after having received a completely positive recommendation from the latter. So, in a certain sense, I also owe my birth to V.Ye. Lashkaryov.

Here, I pay homage to my senior colleagues and teachers, to my father’s fellow student and great friend Volodymyr Lytovchenko, and to Georgii Vadymovich Lashkaryov who was my mother’s friend since his childhood and whom I regularly met for years at all conferences devoted to semiconductor physics. I am also grateful to the Editor-in-chief of *UJP*, President of NASU A.G. Zagorodny, who proposed me to write this article, and to my long-time colleagues from the V.Ye. Lashkaryov Institute of Semiconductor Physics F.T. Vasko and P.S. Smertenko, who read the manuscript of this article and made valuable comments.

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ВАДИМ ЄВГЕНОВИЧ ЛАШКАРЬОВ –
ВИЗНАЧНИЙ УКРАЇНСЬКИЙ ФІЗИК ХХ століття,
ПЕРШОВІДКРИВАЧ p - n -ПЕРЕХОДУ
В НАПІВПРОВІДНИКАХ
(до 120-річчя від дня народження)

Описано життєвий і науковий шлях визначного українського вченого ХХ століття, засновника Інституту фізики напівпровідників НАН України В.Є. Лашкарьова, який у 1941 році надрукував першу в світі статтю, де описано p - n -перехід у закисі міді. Наголос зроблено на особливостях його наукової манери, ролі у вихованні нових поколінь українських фізиків, особистості вченого.

Ключові слова: В.Є. Лашкарьов, напівпровідники, p - n -перехід, контакт, поверхня.