CONSISTENT FORMATION AND DEVELOPMENT OF THE PHYSICS OF SOLIDS IN UZBEKISTAN

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Abstract. *This article briefly describes the formation and development of solid state physics in Uzbekistan. In addition, some scientific research institutes related to physics and their researches in the field of solid state physics and their use in educational activities are discussed.*

It is known from experience that in teaching each subject or educational course to students, mentioning the scientific contributions of our country's scientists to this subject not only develops their national pride, but also increases their interest in the taught subject. We should also emphasize that often we know who are the great thinkers and scientists who came out of our country, but we don't know what their research or contribution to science was. We can call it a methodical error of knowledge given to readers and students. Because when we explain the sections or topics of each subject to the students, it is necessary to give a brief understanding of the research done and being done by the scientists of our country.

Keywords: *because, researches, conducted, after, physics.*

Therefore, it is permissible to bring the researches made by the scientists of our country in the study of the physics of solid bodies and its place in the development of science and technology.

It is of great importance to provide information about the scientific institutions in this field and the conducted or ongoing researches in our country when we organize trainings for the physics and mathematics students of the higher educational institutions of pedagogy on solid state physics, one of the modern sciences.

After solid state physics began to develop as an independent science at the beginning of the 20th century, interest in this science began to increase sharply in our country. In the first half of the 20th century, scientific research centers were gradually established in Uzbekistan, and among other sciences, physics, including solid state physics, began to develop consistently.

The Institute of Physics and Technology, one of the largest scientific research centers in our country, was established in November 1943 on the basis of the physics and technology laboratory of the Uzbekistan branch of the former Academy of Sciences of the USSR. Since then, a scientific institution has started its activity, which conducts scientific investigations in some fields of physics and technology, including the physics of solid bodies.

Since 1967, one of the founders of this scientific center, S.V. Named after Starodubtsev. The institute has 10 scientific laboratories where research works are carried out mainly in four directions. 1. Physics of high energies and cosmic rays, 2. Physics of semiconductors 3. Physics of solid bodies 4. Scientific research works on the problems of using solar energy are carried out.

In three of these areas, the problems of physics of solid bodies are mainly studied [3].

In the field of physics of semiconductors, the initial processes of condensed solid materials in thermal states and the physical processes in them were studied for the first time in the world. Several types of solid solutions with semiconductor properties were created and their physical properties were studied. Through these researches, ultra-high frequency diodes, devices designed

for the study of fast electronic processes in semiconductors, photodiode matrices for image transmission, silicon, lithium detectors, fat diodes, strain gauges and other devices were developed. These devices are widely used in the global electronics industry. Academician M.S. Saidov and the members of his scientific school have done remarkable work in this field, and researches are ongoing.

Based on the theory of solids, a variational method of the perturbation theory was developed and for the first time applied to the study of the dynamics of solitons under the influence of fluctuations and interactions of optical solitons with certain wavelengths. Academician R. A. Mominov and his students made a great contribution to the development of science with several scientific studies. For example, "Nanoobject - a new theoretical model of semiconductor contact structures" and other discoveries have been recognized by world scientists. So far, several international and local scientific projects are in progress.

Visible research has also been conducted in the scientific direction on the problems of using solar energy. Including the synthesis of novel direct-gap semiconductor solid solutions on the basis of which a high-efficiency solar energy production technology was developed, semiconductors doped with deep doped compounds to improve solar energy efficiency, and radiation-resistant and converting elements were created. Many such scientific results can be cited. The results of this research are also widely used in the field of solar energy.

Institute of Nuclear Physics, one of the largest scientific centers in our country, was established in 1956 on the basis of directions and laboratories of the Institute of Physics-Technical Scientific Research. Famous scientists such as Academician I.V. Kurchatov, A.P. Aleksandrov, Yu.B. Khariton, U.A. Arifov and S.A. Azimov were the founders of the establishment of the institute [1]. In September 1959, the first 2,000 kW research nuclear reactor was commissioned in Central Asia. Although this center of science is closely related to the creation of the uranium and later gold mining industry in our Republic, scientists of the institute also began to seriously deal with the problems of solid state physics. Since then, the fields of nuclear and radiation physics, physics of high energies and elementary particles, and theoretical physics have been formed as the main directions, and great achievements have been made over time.

Scientific laboratories of the department "Radiation physics of solid bodies and physics of nanomaterials" were established along with several departments of the institute dealing with physical problems. These include

a) Laboratory of radiation physics and solid state electronics. In this, problems related to solid bodies are studied. Many laws in the processes of irradiation and heat action on crystals have been studied. In order to improve the physical characteristics of the semiconductor material (silicon) under the influence of external factors, technologies for adding additional substances to it have been developed and research is ongoing.

b) Laboratory of radiation physics of optical phenomena. Internal structures of solid bodies and local and volume changes of crystallographic properties, color centers, attachment centers, laws of luminescence formation are studied and researched in this scientific department. s) In the laboratory of physics of nanostructured and superconducting materials, studies were conducted on the synthesis and modification of nano-sized inclusions in glass and crystal matrices under the influence of radiation. In addition, problems of mechanical, electrical, magnetic and optical properties of dielectric, semiconductor and superconducting materials in non-equilibrium state have been studied and scientific progress is being made.

In 1967, the "Electronics" Institute was established on the basis of scientific research directions and laboratories of the Institute of Physics and Technology. Many great Uzbek scientists worked at the institute. Their research on solid state physics is especially important. For example, determination of monomolecular fragmentation of metal cluster ions by ion bombardment by U.Kh.Rasulev, N.Kh.Dzhemilev in 1983, V.V.Lugovskoy, S.T.Azizov, T.B. In 1978-1988, Usmanov's methods of determining the disproportion of the distribution function of metal electrons in the field of laser radiation and many other scientific studies were highly recognized by world scientists. Since 2012, this scientific center has been called the Institute of Ion-Plasma Laser Technologies.

When explaining the types of solids to students, it is impossible not to mention polymers, which are called modern solids. Because polymer materials have entered science and technology or our life so rapidly that there is almost no area where they are not used. Therefore, it is important to organize training on one of the major branches of "Physics of Solids", currently developing as an independent science, "Physics of Polymers".

One of the major research institutes operating in our country that researches the problems of modern solid state physics is the "Polymer Chemistry and Physics" Institute.

The founder and director of the Institute of Chemistry and Physics of Polymers, academician Sayyora Sharafovna Rashidova, who created a well-known school in the field of synthetic and natural polymers, is a distinguished scientist of the Republic of Uzbekistan [2]. In 1979, the Department of Polymer Chemistry of the Academy of Sciences of Uzbekistan was established and was transformed into the Institute of Chemistry and Physics of Polymers of the same year. The main scientific directions were the study of the mechanisms of kinetics and chemical modification of polymers, the synthesis and study of polymer-metal complexes, the study of physiologically active polymers for medicine, veterinary medicine and agriculture, the development and coordination of fundamental research in chemistry, physics and technology. Currently, seven scientific laboratories are operating here. Their main scientific directions are research on synthetic polymers meeting the needs of various sectors of the national economy, solving current problems of polymer science, and establishing the interrelationship between the structure and properties of polymers. The scientists of our country were the first to prove that knowing the dependence of physicochemical properties on the molecular structure allows to regulate the properties of biologically active polymers. Much R&D has been done and is still ongoing to design and develop composite polymer materials with the desired properties. Dozens of patents have been obtained through the results of scientific research and are being applied to production.

One of the youngest scientific centers of our republic is the scientific research institute "Physics of Semiconductors and Microelectronics" under the National University of Uzbekistan, which started its activity in 2018. Eight scientific laboratories are currently operating in this scientific center. In these laboratories, scientific research works are carried out mainly in the fields of physics of solid bodies. For example, in the Laboratory of Semiconductor Physics, research of the physics of various defects mainly formed in semiconductors, i.e., experimental study of the formation processes of heat and radiation defects on the surface and volume of crystalline silicon and other semiconductor materials, defects formed when atoms of other solid bodies are introduced into the silicon crystal and their study of the influence of external factors, etc. [4].

Academician A.T. Under the leadership of Mamadalimov, scientists achieved great results in the field of "experimental study of photoconductivity spectra of natural nanostructured semiconductor fibers and determination of discrete energy levels", studying the possibilities of creating diode structures based on the composite material cotton fiber conducting polymer.

Professor Sh.B.Utamuratova and Kh.S.Daliev's researches on the research of defects formed in semiconductors and the production of semiconductor materials resistant to external factors have been highly recognized by world scientists. In the research institute, significant scientific research is also carried out in the departments of "Semiconductor microelectronics", "Quantum electronics and laser technology laboratory", "Quantum electronics and laser technology laboratory", "Radiation physics of solid bodies", "Semiconductor materials science laboratory".

In addition to these, there are dozens of scientific research institutes and scientific laboratories related to physics at universities in our country. In these centers of science, several scientific schools with their own direction related to the physics of solid bodies have been created.

It should be considered as one of the biggest tasks of educators to convey the information about the above-mentioned scientific centers and the researches carried out and being conducted in them. Citing the scientific work done by the scientists of our country together with the scientists of the world in the training sessions on the topics of solid state physics plays a big role in the increase of students' interest in science.

For example:

№	Passing topic	Contribution of Uzbek scientists
1	Solar elements and their uses	M.S.Saidov "Technology of high-efficiency solar energy production based on the synthesis of new semiconductor solid solutions with a direct cavity, increasing the efficiency of semiconductors doped with deep additive compounds and creating radiation-resistant and transforming elements."
2	Defects in solids	Kh.S.Daliev and Sh.B.Utamuradova "Research of defects formed in semiconductors at different temperatures, methods of obtaining semiconductor materials resistant to external factors"
3.	Optical properties of solids	T. B. Usmanov, R. A. Ganeev, et al., "Methods for determining nonlinear optical parameters of various materials and researching mechanisms that determine their nonlinear optical response"
4.	Polymers and their main properties	S.Sh. Rashidova "Synthesis of polymers and propargyl esters of unsaturated acids and their properties, methods of advanced synthesis of polymers"

We can expand this table further. Because there are contributions of our country's scientists in research related to many topics or sections of physics of solid bodies that we are studying. Incorporating similar information into all physics-related subjects will deepen students' understanding of science and develop their scientific abilities.

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