

- Ray @ S. S. Sharma. Recent Review and Research in Physics, Vo. 10, Ch.5. New Delhi: AkiNik Publications, pp. 65-94.
6. Vavruk, M. V., Smerechynskyi, S. V., Tyshko, N. L. (2018) Novi modeli v strukturі vyrodzhenykh karlykiv [New models in the theory of structure the degenerated dwarfs]. Lviv: Rastr-7, 248 p. [In Ukrainian]

## **Main problems of Relaxed Optical methods of creation and modeling thin films**

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The problem of using the laser radiation in technology of thin films may be classifying in next time [1, 2]:

1. Using the laser radiation for sputtering of irradiated material and applying it to a suitable substrate in a vacuum. The thickness of the applied film depends on the intensity and time of irradiation. The process itself has an orientation character [1, 2].

2. Laser implantation, that is, a change in the physical parameters of the irradiated material in the near-surface area, although volume changes can also be obtained [1, 2].

3. Other various complex treatments, including laser annealing of ion-implanted layers of semiconductor materials, photolithography, etc [1, 2].

For all these three cases, we must take into account the physical and chemical aspects of the interaction of laser radiation with matter.

Hererostructures of laser-sprayed cadmium sulfide on black silicon [1, 2] and copper sulfide also on black silicon [1, 2] were analyzed. Black silicon itself was obtained by physical and chemical methods. It is shown that the sputtering profile of these materials resembles the profile of black silicon. The problem of formation of laser-induced support centers in indium antimonite is considered [1, 2]. Based on the two-dimensional lattice of sphalerite for indium antimonide, a cascade model of the excitation of the corresponding number and type of chemical bonds was constructed, which satisfactorily explains the observed results. In addition, based on this, a model is proposed that explains the influence of reirradiation and reabsorption processes on the distribution of donor centers in indium antimonide and on the shape of their distribution profiles [1].

The formation processes of laser-induced urchin-type surface structures on silicon [] are also explained on the basis of a cascade model of excitation of the corresponding number of chemical bonds (coordination numbers) in the regime of saturation the excitation based on the phase diagram of silicon. It is shown that this process depends on the integral photon efficiency, and upon irradiation with nanosecond pulses of an excimer laser is more effective than when irradiated with femtosecond laser pulses from the near-infrared region of the spectrum.

Using the example of indium antimonide and indium arsenide, the influence of the spectral composition of optical radiation on the laser annealing of ion-implanted layers of these materials is shown [1].

The expediency of using laser radiation in lithography and production of black silicon and other similar structures is also shown [1, 2].

1. Trokhimchuck P. P. "Main Problems of Creation Laser-Induced Thin Films," in *Advances in Engineering Trchnology (ed. Jaivir Singh), vol. 8, ch. 2: 15-47*, AkiNik Publications, New Dehli, 2024.

2. Trokhimchuck P. Some Peculiarities of Creation the Laser-Induced Thin Films. International Journal of Scientific Research and Engineering Trends. Vol. 11, is. 2, 2025. P.1206-1217.

## **Some problems of modelling the optical-induced Cherenkov radiation**

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The main problems of nature the optical-induced Cherenkov radiation are discussed. We show that this problem are connected with problem of shock excitation of heterogeneous polarization the irradiated matter [1-9].

Cherenkov radiation (Vavilov–Cherenkov effect) is electromagnetic radiation emitted when a charged particle (such as an electron) passes through a dielectric medium at a speed greater than the phase velocity (speed of propagation of a wavefront in a medium) of light in that medium [1 – 4, 8, 9]. A classic example of Cherenkov radiation is the characteristic blue glow of an underwater nuclear reactor. Its cause is similar to the cause of a sonic boom, the sharp sound heard when faster-than-sound movement occurs. The phenomenon is named after Soviet physicist Pavel Cherenkov [2, 4].

But Cherenkov radiation may be represented as Nonlinear Optical phenomenon two [8, 9]. Therefore, we must researched this effect in more widely sense as radiational relaxation of shock nonlinear excited heterogeneous polarization. This determination is more widely as traditional. It conclude various ways of excited this polarization, including laser irradiation.

The main problems of nature the optical-induced Cherenkov radiation are discussed. We show that this problem are connected with problem of shock excitation if heterogeneous polarization the irradiated matter. With this point of view the Cherenkov radiation is Nonlinear Optical (NLO) phenomenon [8, 9]. But classical NLO effects are phenomena with homogeneous shock-excited polarization. Two aspects of modeling this phenomenon are observed. First, microscopic, is based on synthesis A. Bohr theory of representation the Cherenkov radiation on the basis the scattering charge particles in media. This theory gives hyperboloid of the shape of the particle's braking track in the medium. Generating cones of Cherenkov radiation are formed by external normals to the A. Bohr hyperboloid [1]. Second, macroscopic is based on I. Golub model of formal analogy Snell law and Cherenkov radiation [3]. Cherenkov speed is determined as speed of shock nonlinear polarization of irradiated matter. Synthesis A. Bohr and I. Golub models allow to determine the product of nonlinear laser-induced refraction index and speed of nonlinear polarization [8, 9]. The essential difference between optically induced and classical (obtained by gamma quanta or charged particles) Cherenkov radiation lies in the radiation distribution spectrum. The classical spectrum is more homogeneous, since each particle "has" its own hyperboloid. For the optical case, we have the number of cones, which is related to the mode structure of laser radiation. So for the TEM<sub>00</sub> fashion we have only one cone [8, 9]. That is why the radiation spectrum will be more heterogeneous, as in the classic case: ultraviolet radiation will be in the central part, and infrared radiation will be at the edges. The observation of laser-induced Cherenkov radiation is connected with problem of diffraction stratification and known as surface continuum radiation [8, 9].

Problems of the observation the Cherenkov radiation and shock processes in matter as Nonlinear (NLO) and Relaxed (RO) Optical processes are connected with acoustic (thermal) and