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THE VLASOV'S EQUATION FOR DESCRIPTION OF SOLIDS STRUCTURE

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One of the main tasks of theoretical physics is to obtain the basic equations for all aggregate states of matter (plasma, gas, liquid, solid). Aggregate states of matter are determined by the location, nature of the motion and interaction of particles. The predominant aggregative state of matter in the universe is plasma. At present, the Vlasov's kinetic equation is the basis of plasma physics. It is used to describe the universe, calculate plasma devices, tokamaks, etc. The Vlasov's equation describes the long-range interaction (or "action at a distance") and, depending on the type of interaction, distinguishes the Vlasov-Poisson, Vlasov-Maxwell, Vlasov-Einstein, and Vlasov-Yang-Mills equations. 70 years ago Vlasov suggested that in order to understand physical processes in systems consisting of many particles, it is necessary to use the equation proposed by him for describing the plasma [1]. In the basis of such approach, Vlasov put the introduction of a unified distribution function that depends on all the coordinates and their derivatives up to any order (non-local statistical mechanics). In modern crystallophysics the fact of the presence of a crystal structure with atoms localized near the lattice sites is not derived from the theory, but is postulated. From the Vlasov's viewpoint, "A crystal is not a postulated construction, but a certain state of motion of particles". As a result of the probabilistic approach, Vlasov obtained the main criterion for the existence of a crystalline state [2]. This criterion contains the condition for the beginning of the process of crystal formation from the homogeneous phase and makes it possible to determine the numerical value of the period. This consideration was carried out by Vlasov for an ideal crystal. A theoretical description of the formation of a real (defective) crystal structure from the viewpoint of the classical approach is based on the model of high-temperature impurity precipitation. In accordance with this model, complexes "intrinsic point defect + impurity atom" are formed near the crystallization front. In the process of crystal cooling, the growth and coalescence of formed precipitates lead to the formation of a defective structure of the crystal. The formation of a defective crystal structure is controlled by its thermal growth conditions (growth rate, temperature gradients, cooling rate) [3]. We checked the positions of Vlasov's physics for real single crystals of semiconductor silicon. We confirmed the fact of complex formation near the crystallization front [4, 5]. The classical and probabilistic models for the formation of a defective crystal structure lead to identical results. The probabilistic approach allows give a new interpretation of the known results of studies of heat-treated crystals. The formation of thermal donors and thermal acceptors occurs as a result of the process of coalescence of impurity precipitates. Based on the solution obtained, three main conclusions can be drawn: (1) Vlasov's theory is a far-reaching and natural extension of classical mechanics. (2) Vlasov's equation can be used to describe any aggregate state of matter. (3) Vlasov's equation is a universal tool for describing the processes taking place in the physical world (both in the macrocosm and in the microcosm).

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