kinetics of phase transitions in condensed matter: van der Pol generator model [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2020.47.1.146

Zmievskaya G.

M.V. Keldysh Institute of applied mathematics Russian Academy of Science, [zmig@mail.ru](mailto:zmig@mail.ru)

Many physical processes, such as turbulence, phase transitions initiated by noise of the first and second kind, including the order-disorder type, polarization of ferroelectrics, chemical transformations, etc. can be modeled as random processes. Nonequilibrium processes in a solid that arise upon implantation of inert gas ions in a thin-layer coating (***SiC / Mo***) of a surface [1, 2] were presented by the Brownian motion model of vacancy-gas defects under the action of collective forces of indirect elastic interaction of spherical non-point defects between themselves and with the boundaries thin layers, the results of the distribution of porosity, structures of pre-cracks and stresses in the model at the times of exposure to the radiation flux, which coincides with the duration of the initial phase of transition.

Brownian motion under the action of an external periodic force on the system is considered as a numerical stochastic kinetic model of the change in polarization in a uniaxial ferroelectric (proportional to the one-dimensional displacement of ions in the crystal lattice upon exposure to a field, ***E cos Ωt***), this type of phase transition is similar to order-disorder phase transitions ( and vice versa). in a solid. Stochastic Langevin equations (***SLE****s*) are formulated for two (+/-) polarization directions ***P (x, V)*** and the corresponding Kolmogorov (Fokker-Planck) equations with nonlinear coefficients. A modification of the algorithms for solving the ***SLE*** of a numerical method for modeling the properties of a ferroelectric is considered. A Gibbs free energy model of the formation of polarization domains as clusters of phase transition nuclei is proposed. The ***SLE*** solution allows one to find the distribution of spontaneous polarization ***P (x, V, t)***, along the trajectories of stochastic dynamic variable coordinates and dipole velocities, ***X (t)*** and ***V (t)****,* to calculate the value of the electric field ***E(t)*** at which the spontaneous polarization is switched at a given sample temperature

The behavior of the stochastic system of the Van der Pol (***VDP***) generator in the presence of noise in the equations for ***X (t)*** and ***V (t)***, symmetrized by nonlinearity, is considered. The analysis was carried out in two different approaches: using the Fokker-Planck-Kolmogorov kinetic equation for the transition probability density (kinetic distribution function ***f (x, V, t)****,* where ***x*** is the coordinate, ***V*** is the velocity, ***t***-time) and systems of stochastic differential equations Langevin. The model allows us to consider the phase transition process in a condensed medium from the point of view of analyzing the behavior of stochastic dynamic variables ***(x, V)*** when changing the ratio of physical quantities that characterize the phase transition: ***α, β, γ***, feedback coefficient, linear and nonlinear friction, respectively. The dependence of the changes ***f (x, V, t)*** of the VDP system on the diffusion coefficient (depending on the noise intensity) for fixed values ​​of ***α, β, γ***and ***f (x, V, t)*** in the phase space of the total energy of the system ***{E}*** is considered.

This work was partially supported by the RFBR grant 18-01-00436.

Literature.

1. [1] G.I. Zmievskaya, A.L. Bondareva // [Journal of Surface Investigation. X-ray, Synchrotron and Neutron Techniques](https://link.springer.com/journal/11700), Volume 10, [Issue 4](https://link.springer.com/journal/11700/10/4/page/1), 802–808. –2016.
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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Pt/ru/GA-Zmievskaya.docx) [↑](#footnote-ref-1)