AN APPROACH TO OPTIMIZE REGIMES OF MANUFACTURING OF COMPLEMENTARY HORIZONTAL FIELD-EFFECT TRANSISTOR

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ABSTRACT

In this paper we consider nonlinear model to describe manufacturing complementary horizontal field-effect heterotransistor. Based on analytical solution of the considered boundary problems some recommendations have been formulated to optimize technological processes.

KEYWORDS

Horizontal field-effect transistor, modelling of manufacturing of transistor, recommendations for optimisation of manufacturing of transistor

1. INTRODUCTION

In the present time it is intensively increasing degree of integration of elements of integrated circuits [1-8]. At the same time it is obtaining decreasing of dimensions of the elements. To decrease dimensions of elements of integrated circuits it is traditionally using some approaches. Two of them are laser and microwave types of annealing of dopants and/or radiation defects during manufacturing *p*-*n*-junctions, field-effect and bipolar transistors, thyristors [9-15]. Another way to increase degree of integration of elements of integrated circuits is using of inhomogeneity of heterostructures on the basis of which integrated circuits are manufactured [13-19]. However in this case it is practicably to optimize annealing of dopant and/or radiation defects. It is known, that distribution of concentrations of dopants in elements of integrated circuits and their discrete analogs will be changed under influence of radiation processing (for example, during ion implantation) [20]. Because of this to decrease dimensions of elements of integrated circuits and their discrete it is attracted an interest radiation processing of materials [21,22].

In this paper we consider manufacturing of complementary field-effect heterotransistor. Structure of the heterotransistor is presented on the Fig. 1. The heterostructure consist of a substrate and epitaxial layer. The epitaxial layer has several sections, which have been manufactured by using another materials. Some dopants have been infused or implanted in the sections to manufacture required types of conductivity (*p* or *n*). Farther we consider annealing of dopant (for doping by diffusion) and/or radiation defects (during ion doping). Main aim of the present paper we analyzed dynamics of redistribution of dopant and radiation defects to formulate conditions, which correspond to manufacture more thin heterotransistor with smaller dimensions into another dimensions.

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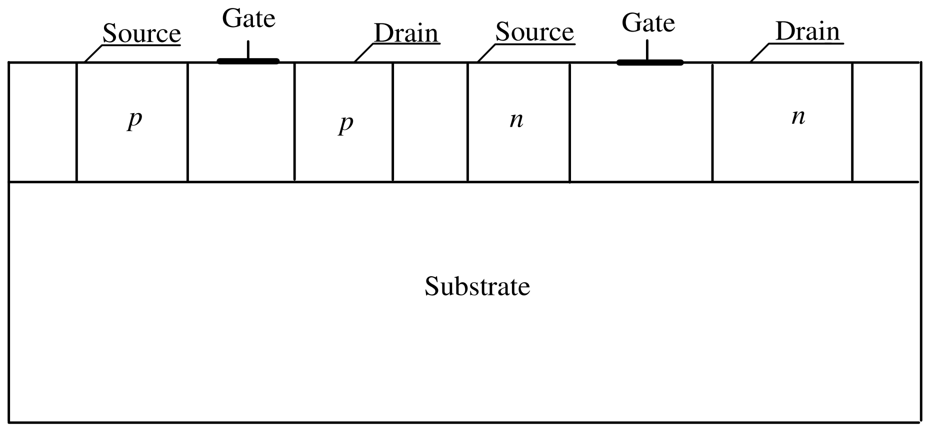

Fig.1. Heterostructure with a substrate and epitaxial layer with several sections

2. METHOD OF SOLUTION

To solve our aims we determine spatio-temporal distribution of concentration of dopant. We determine the distributions by solving the second Fick's law [1,3-5]

$$\frac{\partial C(x,y,z,t)}{\partial t}=\frac{\partial}{\partial x}\left[D_C\frac{\partial C(x,y,z,t)}{\partial x}\right]+\frac{\partial}{\partial y}\left[D_C\frac{\partial C(x,y,z,t)}{\partial y}\right]+\frac{\partial}{\partial z}\left[D_C\frac{\partial C(x,y,z,t)}{\partial z}\right] \quad (1)$$

with boundary and initial conditions

$$\left.\frac{\partial C(x,y,z,t)}{\partial x}\right|_{x=0}=0,\ \left.\frac{\partial C(x,y,z,t)}{\partial x}\right|_{x=L_x}=0,\ \left.\frac{\partial C(x,y,z,t)}{\partial y}\right|_{y=0}=0,\ \left.\frac{\partial C(x,y,z,t)}{\partial y}\right|_{x=L_y}=0, \quad (2)$$

$$\left.\frac{\partial C(x,y,z,t)}{\partial z}\right|_{z=0}=0,\ \left.\frac{\partial C(x,y,z,t)}{\partial z}\right|_{x=L_z}=0,\ C(x,y,z,0)=f(x,y,z).$$

Here $C(x,y,z,t)$ is the spatio-temporal distribution of concentration of dopant; T is the temperature of annealing; D_C is the dopant diffusion coefficient. Value of dopant diffusion coefficient depends on properties of materials in layers of heterostructure, speed of heating and cooling of hetero-structure (with account Arrhenius law). Dependences of dopant diffusion coefficient on parameters could be approximated by the following relation [23-25]

$$D_C=D_L(x,y,z,T)\left[1+\xi\frac{C^{\gamma}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\right]\left[1+\varsigma_1\frac{V(x,y,z,t)}{V^*}+\varsigma_2\frac{V^2(x,y,z,t)}{(V^*)^2}\right], \quad (3)$$

where $D_L(x,y,z,T)$ is the spatial (due to inhomogeneity of heterostructure) and temperature (due to Arrhenius law) dependences of dopant diffusion coefficient; $P(x,y,z,T)$ is the limit of solubility of dopant; parameter γ depends on properties of materials and could be integer in the following interval $\gamma\in[1,3]$ [23]; $V(x,y,z,t)$ is the spatio-temporal distribution of concentration of vacancies; V^* is the equilibrium distribution of concentration of vacancies. Concentrational depen-dence of dopant diffusion coefficient has been discussed in details in the Ref. [23]. It should be noted that doping of heterostructure by diffusion did not leads to generation of radiation damage and $\zeta_1=\zeta_2=$

0. Spatio-temporal distributions of concentrations of point radiation defects we determine by solving the following system equations [24,25]

$$\frac{\partial I(x,y,z,t)}{\partial t}=\frac{\partial}{\partial x}\left[D_I(x,y,z,T)\frac{\partial I(x,y,z,t)}{\partial x}\right]+\frac{\partial}{\partial y}\left[D_I(x,y,z,T)\frac{\partial I(x,y,z,t)}{\partial y}\right]+ \quad (4)$$

$$+\frac{\partial}{\partial z}\left[D_I(x,y,z,T)\frac{\partial I(x,y,z,t)}{\partial z}\right]-k_{I,V}(x,y,z,T)I(x,y,z,t)V(x,y,z,t)-k_{I,I}(x,y,z,T)I^2(x,y,z,t)$$

$$\frac{\partial V(x,y,z,t)}{\partial t}=\frac{\partial}{\partial x}\left[D_V(x,y,z,T)\frac{\partial V(x,y,z,t)}{\partial x}\right]+\frac{\partial}{\partial y}\left[D_V(x,y,z,T)\frac{\partial V(x,y,z,t)}{\partial y}\right]+$$

$$+\frac{\partial}{\partial z}\left[D_V(x,y,z,T)\frac{\partial V(x,y,z,t)}{\partial z}\right]-k_{I,V}(x,y,z,T)I(x,y,z,t)V(x,y,z,t)-k_{V,V}(x,y,z,T)V^2(x,y,z,t)$$

with initial

$$\rho(x,y,z,0)=f_\rho(x,y,z) \quad (5a)$$

and boundary conditions

$$\left.\frac{\partial \rho(x,y,z,t)}{\partial x}\right|_{x=0}=0,\ \left.\frac{\partial \rho(x,y,z,t)}{\partial x}\right|_{x=L_x}=0,\ \left.\frac{\partial \rho(x,y,z,t)}{\partial y}\right|_{y=0}=0,\ \left.\frac{\partial \rho(x,y,z,t)}{\partial y}\right|_{y=L_y}=0,$$

$$\left.\frac{\partial \rho(x,y,z,t)}{\partial z}\right|_{z=0}=0,\ \left.\frac{\partial \rho(x,y,z,t)}{\partial z}\right|_{z=L_z}=0. \quad (5b)$$

Here $\rho=I,V$; $I(x,y,z,t)$ are the spatio-temporal distributions of concentrations of radiation interstitials and radiation vacancies; $D_\rho(x,y,z,T)$ are the diffusion coefficients of the interstitials and vacancies; terms $V^2(x,y,z,t)$ and $I^2(x,y,z,t)$ correspond to generation of divacancies and diinterstitials, respectively; $k_{I,V}(x,y,z,T)$, $k_{I,I}(x,y,z,T)$ and $k_{V,V}(x,y,z,T)$ are parameters of recombination of point defects and generation of their complexes, respectively.

Spatio-temporal distributions of concentrations of divacansies $\Phi_V(x,y,z,t)$ and diinterstitials $\Phi_I(x,y,z,t)$ we determine by solution the following system of equations [24,25]

$$\frac{\partial \Phi_I(x,y,z,t)}{\partial t}=\frac{\partial}{\partial x}\left[D_{\Phi I}(x,y,z,T)\frac{\partial \Phi_I(x,y,z,t)}{\partial x}\right]+\frac{\partial}{\partial y}\left[D_{\Phi I}(x,y,z,T)\frac{\partial \Phi_I(x,y,z,t)}{\partial y}\right]+$$

$$+\frac{\partial}{\partial z}\left[D_{\Phi I}(x,y,z,T)\frac{\partial \Phi_I(x,y,z,t)}{\partial z}\right]+k_{I,I}(x,y,z,T)I^2(x,y,z,t)-k_I(x,y,z,T)I(x,y,z,t) \quad (6)$$

$$\frac{\partial \Phi_V(x,y,z,t)}{\partial t}=\frac{\partial}{\partial x}\left[D_{\Phi V}(x,y,z,T)\frac{\partial \Phi_V(x,y,z,t)}{\partial x}\right]+\frac{\partial}{\partial y}\left[D_{\Phi V}(x,y,z,T)\frac{\partial \Phi_V(x,y,z,t)}{\partial y}\right]+$$

$$+\frac{\partial}{\partial z}\left[D_{\Phi V}(x,y,z,T)\frac{\partial \Phi_V(x,y,z,t)}{\partial z}\right]+k_{V,V}(x,y,z,T)V^2(x,y,z,t)-k_V(x,y,z,T)V(x,y,z,t)$$

with boundary and initial conditions

$$\left.\frac{\partial \Phi_\rho(x,y,z,t)}{\partial x}\right|_{x=0}=0,\ \left.\frac{\partial \Phi_\rho(x,y,z,t)}{\partial x}\right|_{x=L_x}=0,\ \left.\frac{\partial \Phi_\rho(x,y,z,t)}{\partial y}\right|_{y=0}=0,\ \left.\frac{\partial \Phi_\rho(x,y,z,t)}{\partial y}\right|_{y=L_y}=0,$$

$$\left.\frac{\partial \Phi_\rho(x,y,z,t)}{\partial z}\right|_{z=0}=0,\ \left.\frac{\partial \Phi_\rho(x,y,z,t)}{\partial z}\right|_{z=L_z}=0,\ \Phi_I(x,y,z,0)=f_{\Phi I}(x,y,z),\ \Phi_V(x,y,z,0)=f_{\Phi V}(x,y,z). \quad (7)$$

Here $D_{\Phi I}(x,y,z,T)$ and $D_{\Phi V}(x,y,z,T)$ are diffusion coefficients of complexes of point radiation defects; $k_I(x,y,z,T)$ and $k_V(x,y,z,T)$ are parameters of decay of complexes of point radiation defects.

To determine spatio-temporal distributions of concentrations of point radiation defects we used recently elaborated approach [16,19,22]. Framework the approach we transform approximations of diffusion coefficients of point radiation defects to the following form: $D_\rho(x,y,z,T)=D_{0\rho}[1+\varepsilon_\rho g_\rho(x,y,z,T)]$, where $D_{0\rho}$ are the average values of the diffusion coefficients, $0\le\varepsilon_\rho< 1$, $|g_\rho(x,y,z,T)|\le1$, $\rho =I,V$. We used the same transformation for approximations of parameters of recombination of point radiation defects and generation of their complexes: $k_{I,V}(x,y,z,T)=k_{0I,V}[1+\varepsilon_{I,V}\, g_{I,V}(x,y,z,T)]$, $k_{I,I}(x,y,z,T)= k_{0I,I}[1+\varepsilon_{I,I}\, g_{I,I}(x,y,z,T)]$ и $k_{V,V}(x,y,z,T) = k_{0V,V}\,[1+\varepsilon_{V,V}\, g_{V,V}(x,y,z,T)]$, where $k_{0\rho1,\rho2}$ are the appropriate average values, $0\le\varepsilon_{I,V}< 1$, $0\le\varepsilon_{I,I}< 1$, $0\le\varepsilon_{V,V}<\backslash 1$, $|g_{I,V}(x,y,z,T)|\le1$, $|g_{I,I}(x,y,z,T)|\le1$, $|g_{V,V}(x,y,z,T)|\le1$. Let us introduce the following dimensionless variables: $\chi = x/L_x$, $\eta = y/L_y$, $\phi = z/L_z$, $\tilde I(x,y,z,t)=I(x,y,z,t)/I^*$, $\tilde V(x,y,z,t)=V(x,y,z,t)/V^*$, $\vartheta=\sqrt{D_{0I}D_{0V}}\,t/L^2$, $\omega=L^2k_{0I,V}/\sqrt{D_{0I}D_{0V}}$, $\Omega_\rho=L^2k_{0\rho,\rho}/\sqrt{D_{0I}D_{0V}}$. The introduction leads to modification of Eqs.(4) and conditions (5)

$$\frac{\partial \tilde I(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\frac{D_{0I}}{\sqrt{D_{0I}D_{0V}}}\frac{\partial}{\partial \chi}\left\{[1+\varepsilon_I g_I(\chi,\eta,\phi,T)]\frac{\partial \tilde I(\chi,\eta,\phi,\vartheta)}{\partial \chi}\right\}+\frac{\partial}{\partial \eta}\left\{[1+\varepsilon_I g_I(\chi,\eta,\phi,T)]\times\right.$$
$$\left.\times\frac{\partial \tilde I(\chi,\eta,\phi,\vartheta)}{\partial \phi}\right\}\frac{D_{0I}}{\sqrt{D_{0I}D_{0V}}}+\frac{D_{0I}}{\sqrt{D_{0I}D_{0V}}}\frac{\partial}{\partial \phi}\left\{[1+\varepsilon_I g_I(\chi,\eta,\phi,T)]\frac{\partial \tilde I(\chi,\eta,\phi,\vartheta)}{\partial \eta}\right\}-\tilde I(\chi,\eta,\phi,\vartheta)\times$$
$$\times\,\omega\,[1+\varepsilon_{I,V}g_{I,V}(\chi,\eta,\phi,T)]\,\tilde V(\chi,\eta,\phi,\vartheta)-\Omega_I\tilde I^2(\chi,\eta,\phi,\vartheta)[1+\varepsilon_{I,I}g_{I,I}(\chi,\eta,\phi,T)] \quad (8)$$

$$\frac{\partial \tilde V(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\frac{D_{0V}}{\sqrt{D_{0I}D_{0V}}}\frac{\partial}{\partial \chi}\left\{[1+\varepsilon_V g_V(\chi,\eta,\phi,T)]\frac{\partial \tilde V(\chi,\eta,\phi,\vartheta)}{\partial \chi}\right\}+\frac{\partial}{\partial \eta}\left\{[1+\varepsilon_V g_V(\chi,\eta,\phi,T)]\times\right.$$
$$\left.\times\frac{\partial \tilde V(\chi,\eta,\phi,\vartheta)}{\partial \phi}\right\}\frac{D_{0V}}{\sqrt{D_{0I}D_{0V}}}+\frac{D_{0V}}{\sqrt{D_{0I}D_{0V}}}\frac{\partial}{\partial \phi}\left\{[1+\varepsilon_V g_V(\chi,\eta,\phi,T)]\frac{\partial \tilde V(\chi,\eta,\phi,\vartheta)}{\partial \eta}\right\}-\tilde I(\chi,\eta,\phi,\vartheta)\times$$
$$\times\,\omega\,[1+\varepsilon_{I,V}g_{I,V}(\chi,\eta,\phi,T)]\,\tilde V(\chi,\eta,\phi,\vartheta)-\Omega_V\tilde V^2(\chi,\eta,\phi,\vartheta)[1+\varepsilon_{V,V}g_{V,V}(\chi,\eta,\phi,T)]$$

$$\left.\frac{\partial \tilde\rho(\chi,\eta,\phi,\vartheta)}{\partial \chi}\right|_{\chi=0}=0,\ \left.\frac{\partial \tilde\rho(\chi,\eta,\phi,\vartheta)}{\partial \chi}\right|_{\chi=1}=0,\ \left.\frac{\partial \tilde\rho(\chi,\eta,\phi,\vartheta)}{\partial \eta}\right|_{\eta=0}=0,\ \left.\frac{\partial \tilde\rho(\chi,\eta,\phi,\vartheta)}{\partial \eta}\right|_{\eta=1}=0,$$
$$\left.\frac{\partial \tilde\rho(\chi,\eta,\phi,\vartheta)}{\partial \phi}\right|_{\phi=0}=0,\ \left.\frac{\partial \tilde\rho(\chi,\eta,\phi,\vartheta)}{\partial \phi}\right|_{\phi=1}=0,\ \tilde\rho(\chi,\eta,\phi,\vartheta)=\frac{f_\rho(\chi,\eta,\phi,\vartheta)}{\rho^*}. \quad (9)$$

We determine solution of Eqs.(8) and conditions (9) by approach from Refs. [16,19,22], i.e. as the following power series

$$\tilde\rho(\chi,\eta,\phi,\vartheta)=\sum_{i=0}^{\infty}\varepsilon_\rho^i\sum_{j=0}^{\infty}\omega^j\sum_{k=0}^{\infty}\Omega_\rho^k\tilde\rho_{ijk}(\chi,\eta,\phi,\vartheta). \quad (10)$$

Substitution of the series (10) into Eqs.(8) and conditions (9) gives us possibility to obtain equations for initial-order approximations of concentrations of point radiation defects $\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)$ and $\tilde{V}_{000}(\chi,\eta,\phi,\vartheta)$ and corrections for them $\tilde{I}_{ijk}(\chi,\eta,\phi,\vartheta)$ and $\tilde{V}_{ijk}(\chi,\eta,\phi,\vartheta)$, $i \geq 1$, $j \geq 1$, $k \geq 1$. The equations and conditions for them are presented in the Appendix. Solutions of them have been obtained by standard approaches (see, for example, [26,27]). The solutions have been obtained in the Appendix.

Farther we determine spatio-temporal distributions of concentrations of complexes of point radiation defects. To obtain the concentrations we transform approximations of diffusion coefficients to the following form: $D_{\Phi\rho}(x,y,z,T)=D_{0\Phi\rho}[1+\varepsilon_{\Phi\rho}g_{\Phi\rho}(x,y,z,T)]$, where $D_{0\Phi\rho}$ are the average values of diffusion coefficients. After this transformation the Eqs.(6) takes the form

$$\begin{cases} \frac{\partial \Phi_I(x,y,z,t)}{\partial t} = D_{0\Phi I}\frac{\partial}{\partial x}\left\{[1+\varepsilon_{\Phi I}g_{\Phi I}(x,y,z,T)]\frac{\partial \Phi_I(x,y,z,t)}{\partial x}\right\} + D_{0\Phi I}\times \\ \times\frac{\partial}{\partial y}\left\{[1+\varepsilon_{\Phi I}g_{\Phi I}(x,y,z,T)]\frac{\partial \Phi_I(x,y,z,t)}{\partial y}\right\} + \frac{\partial}{\partial z}\left\{[1+\varepsilon_{\Phi I}g_{\Phi I}(x,y,z,T)]\times \right. \\ \left. \times\frac{\partial \Phi_I(x,y,z,t)}{\partial z}\right\}D_{0\Phi I} + k_{I,I}(x,y,z,T)\,I^2(x,y,z,t) - k_I(x,y,z,T)I(x,y,z,t) \\ \frac{\partial \Phi_V(x,y,z,t)}{\partial t} = D_{0\Phi V}\frac{\partial}{\partial x}\left\{[1+\varepsilon_{\Phi V}g_{\Phi V}(x,y,z,T)]\frac{\partial \Phi_V(x,y,z,t)}{\partial x}\right\} + D_{0\Phi V}\times \\ \times\frac{\partial}{\partial y}\left\{[1+\varepsilon_{\Phi V}g_{\Phi V}(x,y,z,T)]\frac{\partial \Phi_V(x,y,z,t)}{\partial y}\right\} + \frac{\partial}{\partial z}\left\{[1+\varepsilon_{\Phi V}g_{\Phi V}(x,y,z,T)]\times \right. \\ \left. \times\frac{\partial \Phi_V(x,y,z,t)}{\partial z}\right\}D_{0\Phi V} + k_{V,V}(x,y,z,T)V^2(x,y,z,t) - k_V(x,y,z,T)V(x,y,z,t) \end{cases}$$

We determine solutions of the above equations as the following power series

$$\Phi_\rho(x,y,z,t) = \sum_{i=0}^{\infty}\varepsilon_{\Phi\rho}^{i}\Phi_{\rho i}(x,y,z,t). \tag{11}$$

Substitution of the series (11) into Eqs.(6) and appropriate boundary and initial conditions gives us possibility to obtain equations for initial-order approximations of concentrations of complexes of point of radiation defects $\Phi_{\rho 0}(x,y,z,t)$, corrections for them $\Phi_{\rho i}(x,y,z,t)$, $i \geq 1$, boundary and initial conditions for all functions $\Phi_{\rho i}(x,y,z,t)$, $i \geq 0$. The equations and conditions are presented in the Appendix. Solutions of the equations have been solved by standard approaches [26,27] and presented in the Appendix.

Spatio-temporal distribution of dopant concentration we determine framework the same approach as for determination of concentrations of radiation defects. Framework the approach we transform approximation of dopant diffusion coefficient in the following form: $D_L(x,y,z,T)= D_{0L}[1+\varepsilon_L g_L(x,y,z,T)]$, D_{0L} is the average value of dopant diffusion coefficient, $0 \leq \varepsilon_L < 1$, $|g_L(x,y,z,T)| \leq 1$. We determine solution of Eq.(1) as the following power series

$$C(x,y,z,t)=\sum_{i=0}^{\infty}\varepsilon_L^i\sum_{j=1}^{\infty}\xi^j C_{ij}(x,y,z,t).$$

Substitution of the series into Eq.(1) and conditions (2) gives us possibility to obtain equations for initial-order approximation of concentration of dopant $C_{00}(x,y,z,t)$, corrections for the approximation $C_{ij}(x,y,z,t)$ ($i\geq1$, $j\geq1$), boundary and initial conditions for all functions $C_{ij}(x,y,z,t)$ ($i\geq0$, $j\geq0$). All these equations and conditions for them are presented in the Appendix. The above equations have been solved by standard approaches (see, for example, [26,27]). The solutions are presented in the Appendix.

Analysis of spatio-temporal distributions of concentrations of dopant and radiation defects have been done analytically by using the second-order approximation by all parameters, which have been used in considered power series. The second-order approximation is usually enough good approximation to make qualitative analysis and to obtain some quantitative results. All analytical results have been checked by numerical simulation.

3. DISCUSSION

In this section based on relations, which have been calculated in previous section, we analyzed dynamics of redistribution of dopant and radiation defects during the annealing. Figs. 2 and 3 shows distributions of concentrations of dopants (for diffusive and ion types of doping) in neighborhood of interface between layers of heterostructure under condition, when dopant diffusion coefficient in the epitaxial layer is larger, than in the substrate. The figure shows, that the interface gives us possibility to manufacture more thin field- effect transistors. Similar choosing of properties of sections in the epitaxial layer gives us possibility to manufacture more compact transistors in other directions.

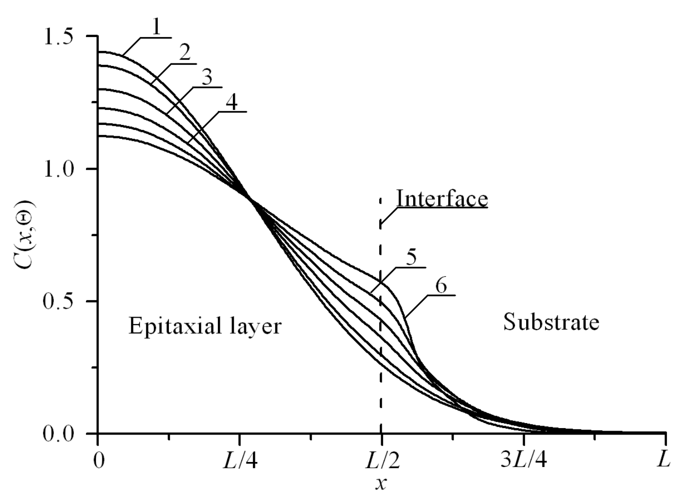

Fig.2. Distributions of concentration of infused dopant in heterostructure from Figs. 1 and 2 in direction, which is perpendicular to interface between epitaxial layer substrate. Increasing of number of curve corresponds to increasing of difference between values of dopant diffusion coefficient in layers of heterostructure under condition, when value of dopant diffusion coefficient in epitaxial layer is larger, than value of dopant diffusion coefficient in substrate

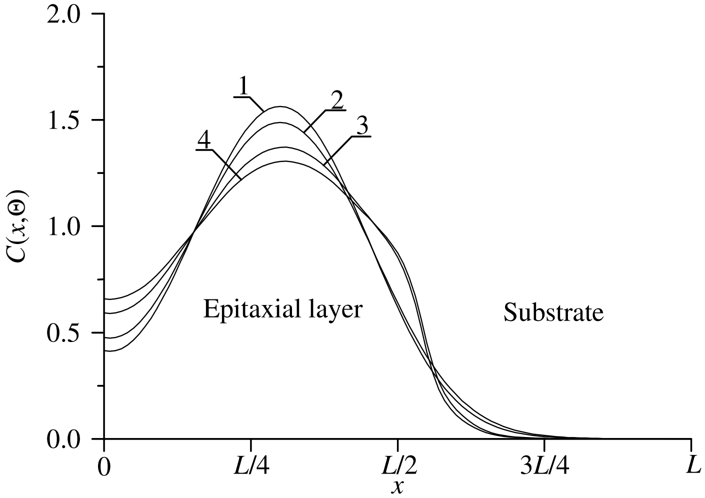

Fig.3. Distributions of concentration of implanted dopant in heterostructure from Figs. 1 and 2 in direction, which is perpendicular to interface between epitaxial layer substrate. Curves 1 and 3 corresponds to annealing time $\Theta = 0.0048(L_x^2+L_y^2+L_z^2)/D_0$. Curves 2 and 4 corresponds to annealing time $\Theta = 0.0057(L_x^2+L_y^2+L_z^2)/D_0$. Curves 1 and 2 corresponds to homogenous sample. Curves 3 and 4 corresponds to heterostructure under condition, when value of dopant diffusion coefficient in epitaxial layer is larger, than value of dopant diffusion coefficient in substrate

It should be noted, that interface between layers of heterostructure leads to influence on distribution of concentration of dopant at appropriate value of annealing time: annealing time of dopant should be neither much, no small. In this situation it should be done optimization of annealing. The optimization of annealing has been done framework recently introduce criterion [13-19,21,22]. By using the optimization we obtain values of optimal annealing time. Dependences of the values are presented on the Figs. 4 and 5. It should be noted, that after ion implantation one shall make annealing of radiation defects. One can find spreading of distribution of concentration of dopant during the annealing. In the ideal case parameters of technological process should be chosen so, that after finishing the annealing dopant should achieve interface between layers of heterostructure. If after finishing of the annealing dopant did not achieved the interface, it is attracted an interest additional annealing of dopant. In this situation additional optimal annealing time of dopant decreases in the case of ion doping.

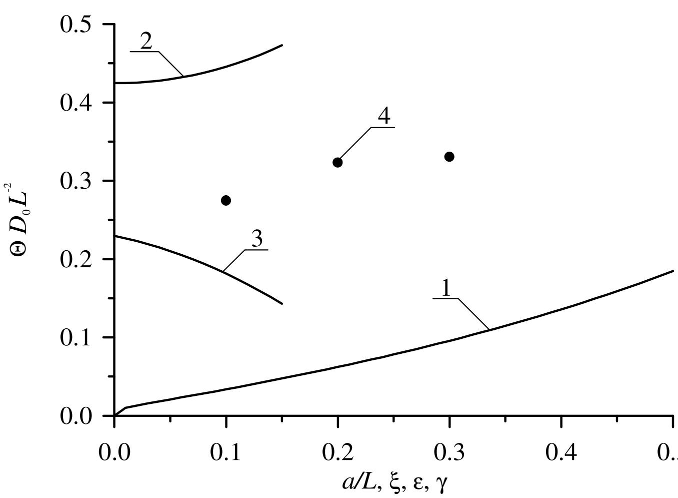

Fig.4. Dependences of dimensionless optimal annealing time for doping by diffusion, which have been obtained by minimization of mean-squared error, on several parameters. Curve 1 is the dependence of dimensionless optimal annealing time on the relation *a/L* and $\xi=\gamma=0$ for equal to each other values of dopant diffusion coefficient in all parts of heterostructure. Curve 2 is the dependence of dimensionless optimal annealing time on value of parameter ε for *a/L*=1/2 and $\xi=\gamma=0$. Curve 3 is the dependence of dimensionless optimal annealing time on value of parameter ξ for *a/L*=1/2 and $\varepsilon=\gamma=0$. Curve 4 is the dependence of dimensionless optimal annealing time on value of parameter γ for *a/L*=1/2 and $\varepsilon=\xi=0$

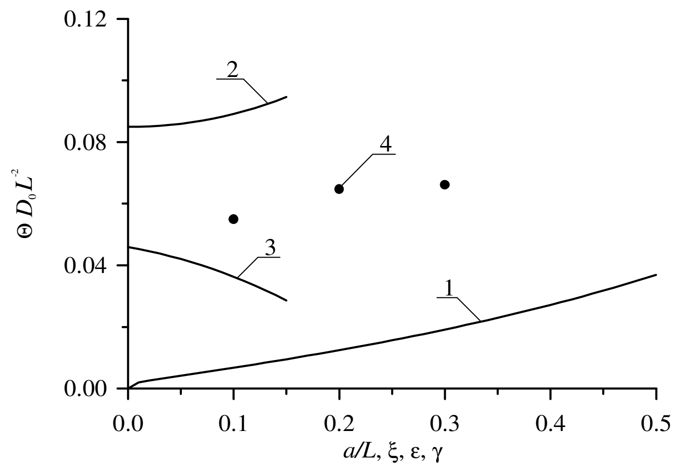

Fig.5. Dependences of dimensionless optimal annealing time for doping by ion implantation, which have been obtained by minimization of mean-squared error, on several parameters. Curve 1 is the dependence of dimensionless optimal annealing time on the relation *a/L* and $\xi=\gamma=0$ for equal to each other values of dopant diffusion coefficient in all parts of heterostructure. Curve 2 is the dependence of dimensionless optimal annealing time on value of parameter ε for *a/L*=1/2 and $\xi=\gamma=0$. Curve 3 is the dependence of dimensionless optimal annealing time on value of parameter ξ for *a/L*=1/2 and $\varepsilon=\gamma=0$. Curve 4 is the dependence of dimensionless optimal annealing time on value of parameter γ for *a/L*=1/2 and $\varepsilon=\xi=0$

4. CONCLUSION

In this paper we introduce an approach to manufacture thinner field-effect heterotransistor with decreasing of their dimensions into another directions.

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APPENDIX

Equations for the functions $\tilde{I}_{ijk}(\chi,\eta,\phi,\vartheta)$ and $\tilde{V}_{ijk}(\chi,\eta,\phi,\vartheta)$, $i\ge 0$, $j\ge 0$, $k\ge 0$ and conditions for them are

$$\frac{\partial \tilde{I}_{000}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{000}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{000}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{000}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}$$

$$\frac{\partial \tilde{V}_{000}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{000}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{000}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{000}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2};$$

$$\frac{\partial \tilde{I}_{i00}(\chi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{i00}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{i00}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{i00}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}+$$
$$+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial}{\partial \chi}\left[g_I(\chi,\eta,\phi,T)\frac{\partial \tilde{I}_{i-100}(\chi,\eta,\phi,\vartheta)}{\partial \chi}\right]+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial}{\partial \eta}\left[g_I(\chi,\eta,\phi,T)\frac{\partial \tilde{I}_{i-100}(\chi,\eta,\phi,\vartheta)}{\partial \eta}\right]+$$
$$+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial}{\partial \phi}\left[g_I(\chi,\eta,\phi,T)\frac{\partial \tilde{I}_{i-100}(\chi,\eta,\phi,\vartheta)}{\partial \phi}\right]$$

$$\frac{\partial \tilde{V}_{i00}(\chi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{i00}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{i00}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{i00}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}+$$
$$+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial}{\partial \chi}\left[g_V(\chi,\eta,\phi,T)\frac{\partial \tilde{V}_{i-100}(\chi,\eta,\phi,\vartheta)}{\partial \chi}\right]+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial}{\partial \eta}\left[g_V(\chi,\eta,\phi,T)\frac{\partial \tilde{V}_{i-100}(\chi,\eta,\phi,\vartheta)}{\partial \eta}\right]+$$
$$+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial}{\partial \phi}\left[g_V(\chi,\eta,\phi,T)\frac{\partial \tilde{V}_{i-100}(\chi,\eta,\phi,\vartheta)}{\partial \phi}\right],\ i\geq 1;$$

$$\frac{\partial \tilde{I}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0I}}{D_{0V}}}\left[\frac{\partial^2 \tilde{I}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\frac{\partial^2 \tilde{I}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\frac{\partial^2 \tilde{I}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}\right]-$$
$$-\left[1+\varepsilon_{I,V}\,g_{I,V}(\chi,\eta,\phi,T)\right]\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)\,\tilde{V}_{000}(\chi,\eta,\phi,\vartheta)$$

$$\frac{\partial \tilde{V}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0V}}{D_{0I}}}\left[\frac{\partial^2 \tilde{V}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\frac{\partial^2 \tilde{V}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\frac{\partial^2 \tilde{V}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}\right]+$$
$$-\left[1+\varepsilon_{I,V}\,g_{I,V}(\chi,\eta,\phi,T)\right]\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)\tilde{V}_{000}(\chi,\eta,\phi,\vartheta);$$

$$\frac{\partial \tilde{I}_{020}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0I}}{D_{0V}}}\left[\frac{\partial^2 \tilde{I}_{020}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\frac{\partial^2 \tilde{I}_{020}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\frac{\partial^2 \tilde{I}_{020}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}\right]-$$
$$-\left[1+\varepsilon_{I,V}\,g_{I,V}(\chi,\eta,\phi,T)\right]\left[\tilde{I}_{010}(\chi,\eta,\phi,\vartheta)\,\tilde{V}_{000}(\chi,\eta,\phi,\vartheta)+\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)\tilde{V}_{010}(\chi,\eta,\phi,\vartheta)\right]$$

$$\frac{\partial \tilde{V}_{020}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0I}}{D_{0V}}}\left[\frac{\partial^2 \tilde{V}_{020}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\frac{\partial^2 \tilde{V}_{020}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\frac{\partial^2 \tilde{V}_{020}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}\right]-$$
$$-\left[1+\varepsilon_{I,V}\,g_{I,V}(\chi,\eta,\phi,T)\right]\left[\tilde{I}_{010}(\chi,\eta,\phi,\vartheta)\tilde{V}_{000}(\chi,\eta,\phi,\vartheta)+\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)\tilde{V}_{010}(\chi,\eta,\phi,\vartheta)\right];$$

$$\frac{\partial \tilde{I}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0I}}{D_{0V}}}\left[\frac{\partial^2 \tilde{I}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\frac{\partial^2 \tilde{I}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\frac{\partial^2 \tilde{I}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}\right]-$$
$$-\left[1+\varepsilon_{I,I}\,g_{I,I}(\chi,\eta,\phi,T)\right]\tilde{I}^2_{000}(\chi,\eta,\phi,\vartheta)$$

$$\frac{\partial \tilde{V}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0V}}{D_{0I}}}\left[\frac{\partial^2 \tilde{V}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\frac{\partial^2 \tilde{V}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\frac{\partial^2 \tilde{V}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}\right]- -\left[1+\varepsilon_{I,I}\, g_{I,I}(\chi,\eta,\phi,T)\right]\tilde{V}^2_{000}(\chi,\eta,\phi,\vartheta);$$

$$\frac{\partial \tilde{I}_{110}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{110}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{110}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{110}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}+ +\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial}{\partial \chi}\left[g_I(\chi,\eta,\phi,T)\frac{\partial \tilde{I}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \chi}\right]+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial}{\partial \eta}\left[g_I(\chi,\eta,\phi,T)\frac{\partial \tilde{I}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \eta}\right]+ +\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial}{\partial \phi}\left[g_I(\chi,\eta,\phi,T)\frac{\partial \tilde{I}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \phi}\right]-\left[1+\varepsilon_{I,I}\, g_{I,I}(\chi,\eta,\phi,T)\right]\times \times\left[\tilde{I}_{100}(\chi,\eta,\phi,\vartheta)\tilde{V}_{000}(\chi,\eta,\phi,\vartheta)+\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)\tilde{V}_{100}(\chi,\eta,\phi,\vartheta)\right]$$

$$\frac{\partial \tilde{V}_{110}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{110}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{110}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{110}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}+ +\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial}{\partial \chi}\left[g_V(\chi,\eta,\phi,T)\frac{\partial \tilde{V}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \chi}\right]+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial}{\partial \eta}\left[g_V(\chi,\eta,\phi,T)\frac{\partial \tilde{V}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \eta}\right]+ +\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial}{\partial \phi}\left[g_V(\chi,\eta,\phi,T)\frac{\partial \tilde{V}_{010}(\chi,\eta,\phi,\vartheta)}{\partial \phi}\right]-\left[1+\varepsilon_{V,V}\, g_{V,V}(\chi,\eta,\phi,T)\right]\times \times\left[\tilde{V}_{100}(\chi,\eta,\phi,\vartheta)\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)+\tilde{V}_{000}(\chi,\eta,\phi,\vartheta)\tilde{I}_{100}(\chi,\eta,\phi,\vartheta)\right];$$

$$\frac{\partial \tilde{I}_{002}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{002}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{002}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{002}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}- -\left[1+\varepsilon_{I,I}\, g_{I,I}(\chi,\eta,\phi,T)\right]\tilde{I}_{001}(\chi,\eta,\phi,\vartheta)\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)$$

$$\frac{\partial \tilde{V}_{002}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{002}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{002}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{002}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}+ -\left[1+\varepsilon_{V,V}\, g_{V,V}(\chi,\eta,\phi,E)\right]\tilde{V}_{001}(\chi,\eta,\phi,\vartheta)\tilde{V}_{000}(\chi,\eta,\phi,\vartheta);$$

$$\frac{\partial \tilde{I}_{101}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{101}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{101}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2 \tilde{I}_{101}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}+ +\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial}{\partial \chi}\left[g_I(\chi,\eta,\phi,T)\frac{\partial \tilde{I}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \chi}\right]+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial}{\partial \eta}\left[g_I(\chi,\eta,\phi,T)\frac{\partial \tilde{I}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \eta}\right]+ +\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial}{\partial \phi}\left[g_I(\chi,\eta,\phi,T)\frac{\partial \tilde{I}_{001}(\chi,\eta,\phi,\vartheta)}{\partial \phi}\right]-\left[1+\varepsilon_I\, g_I(\chi,\eta,\phi,T)\right]\tilde{I}_{100}(\chi,\eta,\phi,\vartheta)\tilde{V}_{000}(\chi,\eta,\phi,\vartheta)$$

$$\frac{\partial \tilde{V}_{101}(\chi,\eta,\phi,\vartheta)}{\partial \vartheta}=\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{101}(\chi,\eta,\phi,\vartheta)}{\partial \chi^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{101}(\chi,\eta,\phi,\vartheta)}{\partial \eta^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2 \tilde{V}_{101}(\chi,\eta,\phi,\vartheta)}{\partial \phi^2}+$$

$$+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial}{\partial\chi}\left[g_V(\chi,\eta,\phi,T)\frac{\partial\tilde{V}_{001}(\chi,\eta,\phi,\vartheta)}{\partial\chi}\right]+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial}{\partial\eta}\left[g_V(\chi,\eta,\phi,T)\frac{\partial\tilde{V}_{001}(\chi,\eta,\phi,\vartheta)}{\partial\eta}\right]+$$
$$+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial}{\partial\phi}\left[g_V(\chi,\eta,\phi,T)\frac{\partial\tilde{V}_{001}(\chi,\eta,\phi,\vartheta)}{\partial\phi}\right]-[1+\varepsilon_V g_V(\chi,\eta,\phi,T)]\,\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)\tilde{V}_{100}(\chi,\eta,\phi,\vartheta);$$

$$\frac{\partial\tilde{I}_{011}(\chi,\eta,\phi,\vartheta)}{\partial\vartheta}=\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2\tilde{I}_{011}(\chi,\eta,\phi,\vartheta)}{\partial\chi^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2\tilde{I}_{011}(\chi,\eta,\phi,\vartheta)}{\partial\eta^2}+\sqrt{\frac{D_{0I}}{D_{0V}}}\frac{\partial^2\tilde{I}_{011}(\chi,\eta,\phi,\vartheta)}{\partial\phi^2}-$$
$$-[1+\varepsilon_{I,I}g_{I,I}(\chi,\eta,\phi,T)]\,\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)\tilde{I}_{010}(\chi,\eta,\phi,\vartheta)-$$
$$-[1+\varepsilon_{I,V}g_{I,V}(\chi,\eta,\phi,T)]\,\tilde{I}_{001}(\chi,\eta,\phi,\vartheta)\;\tilde{V}_{000}(\chi,\eta,\phi,\vartheta)$$

$$\frac{\partial\tilde{V}_{011}(\chi,\eta,\phi,\vartheta)}{\partial\vartheta}=\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2\tilde{V}_{011}(\chi,\eta,\phi,\vartheta)}{\partial\chi^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2\tilde{V}_{011}(\chi,\eta,\phi,\vartheta)}{\partial\eta^2}+\sqrt{\frac{D_{0V}}{D_{0I}}}\frac{\partial^2\tilde{V}_{011}(\chi,\eta,\phi,\vartheta)}{\partial\phi^2}-$$
$$-[1+\varepsilon_{V,V}g_{V,V}(\chi,\eta,\phi,T)]\,\tilde{V}_{000}(\chi,\eta,\phi,\vartheta)\tilde{V}_{010}(\chi,\eta,\phi,\vartheta)-$$
$$-[1+\varepsilon_{I,V}g_{I,V}(\chi,\eta,\phi,t)]\,\tilde{I}_{000}(\chi,\eta,\phi,\vartheta)\,\tilde{V}_{001}(\chi,\eta,\phi,\vartheta);$$

$$\left.\frac{\partial\tilde{\rho}_{ijk}(\chi,\eta,\phi,\vartheta)}{\partial\chi}\right|_{x=0}=0,\;\left.\frac{\partial\tilde{\rho}_{ijk}(\chi,\eta,\phi,\vartheta)}{\partial\chi}\right|_{x=1}=0,\;\left.\frac{\partial\tilde{\rho}_{ijk}(\chi,\eta,\phi,\vartheta)}{\partial\eta}\right|_{\eta=0}=0,$$

$$\left.\frac{\partial\tilde{\rho}_{ijk}(\chi,\eta,\phi,\vartheta)}{\partial\eta}\right|_{\eta=1}=0,\;\left.\frac{\partial\tilde{\rho}_{ijk}(\chi,\eta,\phi,\vartheta)}{\partial\phi}\right|_{\phi=0}=0,\;\left.\frac{\partial\tilde{\rho}_{ijk}(\chi,\eta,\phi,\vartheta)}{\partial\phi}\right|_{\phi=1}=0\;\;(i\geq0,\,j\geq0,\,k\geq0);$$

$$\tilde{\rho}_{000}(\chi,\eta,\phi,0)=f_\rho(\chi,\eta,\phi)/\rho^*,\;\;\tilde{\rho}_{ijk}(\chi,\eta,\phi,0)=0\;\;(i\geq1,\,j\geq1,\,k\geq1).$$

Solutions of these equations with account boundary and initial conditions could be written as

$$\tilde{\rho}_{000}(\chi,\eta,\phi,\vartheta)=\frac{1}{L}+\frac{2}{L}\sum_{n=1}^{\infty}F_{n\rho}c(\chi)c(\eta)c(\phi)e_{n\rho}(\vartheta),$$

where $F_{n\rho}=\frac{1}{\rho^*}\int_0^1\cos(\pi nu)\int_0^1\cos(\pi nv)\int_0^1\cos(\pi nw)f_{n\rho}(u,v,w)\,d\,w\,d\,v\,d\,u$, $c_n(\chi)=co.\,(\pi n\,\chi)$, $e_{nI}(\vartheta)=$
$=\exp\left(-\pi^2n^2\vartheta\sqrt{D_{0V}/D_{0I}}\right)$, $e_{nV}(\vartheta)=\exp\left(-\pi^2n^2\vartheta\sqrt{D_{0I}/D_{0V}}\right)$;

$$\tilde{I}_{i00}(\chi,\eta,\phi,\vartheta)=-2\pi\sqrt{\frac{D_{0I}}{D_{0V}}}\sum_{n=1}^{\infty}n\,c_n(\chi)c(\eta)c(\phi)e_{nI}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 s_n(u)\int_0^1 c_n(v)\int_0^1\frac{\partial\tilde{I}_{i-100}(u,v,w,\tau)}{\partial u}\times$$
$$\times c_n(w)g_I(u,v,w,T)\,d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0I}}{D_{0V}}}\sum_{n=1}^{\infty}c_n(\chi)c(\eta)c(\phi)e_{nI}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\int_0^1 s_n(v)\times$$
$$\times n\int_0^1 c_n(w)\,g_I(u,v,w,T)\frac{\partial\tilde{I}_{i-100}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0I}}{D_{0V}}}\sum_{n=1}^{\infty}n\,c_n(\chi)\,c(\eta)c(\phi)e_{nI}(\vartheta)\times$$
$$\times\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1 s_n(w)g_I(u,v,w,T)\frac{\partial\tilde{I}_{i-100}(u,v,w,\tau)}{\partial w}d\,w\,d\,v\,d\,u\,d\,\tau$$

$$\tilde{V}_{i00}(\chi,\eta,\phi,\vartheta)=-2\pi\sqrt{\frac{D_{0V}}{D_{0I}}}\sum_{n=1}^{\infty}n\,c_n(\chi)c(\eta)c(\phi)e_{nV}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 s_n(u)\int_0^1 c_n(v)\int_0^1 c_n(w)\frac{\partial\tilde{V}_{i-100}(u,\tau)}{\partial u}\times$$
$$\times\ g_V(u,v,w,T)\,d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0V}}{D_{0I}}}\sum_{n=1}^{\infty}c_n(\chi)c(\eta)c(\phi)e_{nV}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\int_0^1 s_n(v)\int_0^1 c_n(w)\times$$
$$\times n\ g_V(u,v,w,T)\frac{\partial\tilde{V}_{i-100}(u,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0V}}{D_{0I}}}\sum_{n=1}^{\infty}c_n(\chi)c(\eta)c(\phi)e_{nV}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\times$$
$$\times\ n\int_0^1 c_n(v)\int_0^1 s_n(w)\,g_V(u,v,w,T)\frac{\partial\tilde{V}_{i-100}(u,\tau)}{\partial w}d\,w\,d\,v\,d\,u\,d\,\tau\ ,\ i\geq 1,$$

where $s_n(\chi)=sin(\pi n\chi)$;

$$\tilde{\rho}_{010}(\chi,\eta,\phi,\vartheta)=-2\sum_{n=1}^{\infty}c_n(\chi)c_n(\eta)c_n(\phi)e_{n\rho}(\vartheta)\int_0^{\vartheta}e_{n\rho}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1 c_n(w)\times$$
$$\times\left[1+\varepsilon_{I,V}\,g_{I,V}(u,v,w,T)\right]\tilde{I}_{000}(u,v,w,\tau)\tilde{V}_{000}(u,v,w,\tau)d\,w\,d\,v\,d\,u\,d\,\tau\ ;$$

$$\tilde{\rho}_{020}(\chi,\eta,\phi,\vartheta)=-2\sqrt{\frac{D_{0I}}{D_{0V}}}\sum_{n=1}^{\infty}c_n(\chi)c_n(\eta)c_n(\phi)e_{n\rho}(\vartheta)\int_0^{\vartheta}e_{n\rho}(-\tau)\int_0^1\int_0^1\int_0^1\left[1+\varepsilon_{I,V}\,g_{I,V}(u,v,w,T)\right]\times$$
$$\times c_n(u)c_n(v)c_n(w)\left[\tilde{I}_{010}(u,v,w,\tau)\tilde{V}_{000}(u,v,w,\tau)+\tilde{I}_{000}(u,v,w,\tau)\tilde{V}_{010}(u,v,w,\tau)\right]d\,w\,d\,v\,d\,u\,d\,\tau\ ;$$

$$\tilde{\rho}_{001}(\chi,\eta,\phi,\vartheta)=-2\sum_{n=1}^{\infty}c_n(\chi)c_n(\eta)c_n(\phi)e_{n\rho}(\vartheta)\int_0^{\vartheta}e_{n\rho}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1 c_n(w)\times$$
$$\times\left[1+\varepsilon_{\rho,\rho}\,g_{\rho,\rho}(u,v,w,T)\right]\tilde{\rho}_{000}^{2}(u,v,w,\tau)d\,w\,d\,v\,d\,u\,d\,\tau\ ;$$

$$\tilde{\rho}_{002}(\chi,\eta,\phi,\vartheta)=-2\sum_{n=1}^{\infty}c_n(\chi)c_n(\eta)c_n(\phi)e_{n\rho}(\vartheta)\int_0^{\vartheta}e_{n\rho}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1 c_n(w)\times$$
$$\times\left[1+\varepsilon_{\rho,\rho}\,g_{\rho,\rho}(u,v,w,T)\right]\tilde{\rho}_{001}(u,v,w,\tau)\,\tilde{\rho}_{000}(u,v,w,\tau)d\,w\,d\,v\,d\,u\,d\,\tau\ ;$$

$$\tilde{I}_{110}(\chi,\eta,\phi,\vartheta)=-2\pi\sqrt{\frac{D_{0I}}{D_{0V}}}\sum_{n=1}^{\infty}c_n(\chi)c_n(\eta)c_n(\phi)e_{nI}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 s_n(u)\int_0^1 c_n(v)\int_0^1 c_n(u)\ g_I(u,v,w,T)\times$$
$$\times n\frac{\partial\tilde{I}_{i-100}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0I}}{D_{0V}}}\sum_{n=1}^{\infty}n\ c_n(\chi)c_n(\eta)c_n(\phi)e_{nI}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\int_0^1 s_n(v)\times$$
$$\times\int_0^1 c_n(u)g_I(u,v,w,T)\frac{\partial\tilde{I}_{i-100}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0I}}{D_{0V}}}\times\sum_{n=1}^{\infty}n\,c_n(\chi)c_n(\eta)c_n(\phi)e_{nI}(\vartheta)\times$$
$$\times\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1 s_n(u)g_I(u,v,w,T)\frac{\partial\tilde{I}_{i-100}(u,v,w,\tau)}{\partial w}d\,w\,d\,v\,d\,u\,d\,\tau-2\sum_{n=1}^{\infty}c_n(\chi)c_n(\eta)c_n(\phi)\times$$
$$\times\,e_{nI}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1\left[\tilde{I}_{100}(u,v,w,\tau)\,\tilde{V}_{000}(u,v,w,\tau)+\tilde{I}_{000}(u,v,w,\tau)\tilde{V}_{100}(u,v,w,\tau)\right]\times$$
$$\times\left[1+\varepsilon_{I,V}\,g_{I,V}(u,v,w,T)\right]c_n(w)\ d\,w\,d\,v\,d\,u\,d\,\tau$$

$$\tilde{V}_{110}(\chi,\eta,\phi,\vartheta)=-2\pi\sqrt{\frac{D_{0V}}{D_{0I}}}\sum_{n=1}^{\infty}n\,c_n(\chi)c_n(\eta)c_n(\phi)e_{nV}(\vartheta)\int_0^{\vartheta}e_{nV}(-\tau)\int_0^1 s_n(u)\int_0^1 c_n(v)\int_0^1 g_V(u,v,w,T)\times$$

$$\times c_n(u)\frac{\partial \tilde{V}_{i-100}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0V}}{D_{0I}}}\sum_{n=1}^{\infty}c_n(\chi)c_n(\eta)c_n(\phi)e_{nV}(\vartheta)\int_0^{\vartheta}e_{nV}(-\tau)\int_0^1 c_n(u)\times$$

$$\times n\int_0^1 s_n(v)\int_0^1 c_n(u)g_V(u,v,w,T)\frac{\partial \tilde{V}_{i-100}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0V}}{D_{0I}}}\sum_{n=1}^{\infty}e_{nV}(\vartheta)\int_0^{\vartheta}e_{nV}(-\tau)\times$$

$$\times n\;c_n(\chi)c_n(\eta)c_n(\phi)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1 s_n(u)g_V(u,v,w,T)\frac{\partial \tilde{V}_{i-100}(u,v,w,\tau)}{\partial w}d\,w\,d\,v\,d\,u\,d\,\tau-2\sum_{n=1}^{\infty}c_n(\chi)\times$$

$$\times c_n(\eta)c_n(\phi)\,e_{nI}(\vartheta)\int_0^{\vartheta}e_{nV}(-\tau)\int_0^1 c_n(u)\int_0^1\int_0^1\left[\tilde{I}_{100}(u,v,w,\tau)\,\tilde{V}_{000}(u,v,w,\tau)+\tilde{I}_{000}(u,v,w,\tau)\tilde{V}_{100}(u,v,w,\tau)\right]\times$$
$$\times c_n(w)d\,w\,c_n(v)\;d\,v\,d\,u\,d\,\tau\,;$$

$$\tilde{I}_{101}(\chi,\eta,\phi,\vartheta)=-2\pi\sqrt{\frac{D_{0I}}{D_{0V}}}\sum_{n=1}^{\infty}n\,c_n(\chi)c_n(\eta)c_n(\phi)e_{nI}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 s_n(u)\int_0^1 c_n(v)\int_0^1 c_n(w)\;g_I(u,v,w,T)\times$$

$$\times\frac{\partial \tilde{I}_{001}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0I}}{D_{0V}}}\sum_{n=1}^{\infty}n\,c_n(\chi)c_n(\eta)c_n(\phi)e_{nI}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\int_0^1 s_n(v)\times$$

$$\times\int_0^1 c_n(w)\;g_I(u,v,w,T)\frac{\partial \tilde{I}_{001}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0I}}{D_{0V}}}\sum_{n=1}^{\infty}n\,c_n(\chi)c_n(\eta)c_n(\phi)e_{nI}(\vartheta)\times$$

$$\times\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1 s_n(w)g_I(u,v,w,T)\frac{\partial \tilde{I}_{001}(u,v,w,\tau)}{\partial w}d\,w\,d\,v\,d\,u\,d\,\tau-2\sum_{n=1}^{\infty}c_n(\chi)c_n(\eta)\times$$

$$\times c_n(\phi)e_{nI}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1\left[1+\varepsilon_{I,V}\,g_{I,V}(u,v,w,T)\right]\tilde{I}_{100}(u,v,w,\tau)\tilde{V}_{000}(u,v,w,\tau)\times$$
$$\times c_n(w)\;d\,w\,d\,v\,d\,u\,d\,\tau$$

$$\tilde{V}_{101}(\chi,\eta,\phi,\vartheta)=-2\pi\sqrt{\frac{D_{0V}}{D_{0I}}}\sum_{n=1}^{\infty}n\,c_n(\chi)c_n(\eta)c_n(\phi)e_{nV}(\vartheta)\int_0^{\vartheta}e_{nV}(-\tau)\int_0^1 s_n(u)\int_0^1 c_n(v)\int_0^1 g_V(u,v,w,T)\times$$

$$\times c\,(w)\frac{\partial \tilde{V}_{001}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0V}}{D_{0I}}}\sum_{n=1}^{\infty}n\,c_n(\chi)c_n(\eta)c_n(\phi)e_{nV}(\vartheta)\int_0^{\vartheta}e_{nV}(-\tau)\int_0^1 c_n(u)\times$$

$$\times\int_0^1 s_n(v)\int_0^1 c_n(w)g_V(u,v,w,T)\frac{\partial \tilde{V}_{001}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-2\pi\sqrt{\frac{D_{0V}}{D_{0I}}}\sum_{n=1}^{\infty}n\,c_n(\chi)c_n(\eta)c_n(\phi)\times$$

$$\times e_{nV}(\vartheta)\int_0^{\vartheta}e_{nV}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1 s_n(w)g_V(u,v,w,T)\frac{\partial \tilde{V}_{001}(u,v,w,\tau)}{\partial w}d\,w\,d\,v\,d\,u\,d\,\tau-2\sum_{n=1}^{\infty}c_n(\chi)\times$$

$$\times c_n(\eta)c_n(\phi)e_{nV}(\vartheta)\int_0^{\vartheta}e_{nV}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1\left[1+\varepsilon_{I,V}\,g_{I,V}(u,v,w,T)\right]\tilde{I}_{000}(u,v,w,\tau)\,\tilde{V}_{100}(u,v,w,\tau)\times$$
$$\times c_n(w)\,d\,w\,d\,v\,d\,u\,d\,\tau\,;$$

$$\tilde{I}_{011}(\chi,\eta,\phi,\vartheta)=-2\sum_{n=1}^{\infty}c_n(\chi)c_n(\eta)c_n(\phi)e_{nI}(\vartheta)\int_0^{\vartheta}e_{nI}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1\left\{\left[1+\varepsilon_{I,I}\,g_{I,I}(u,v,w,T)\right]\times\right.$$
$$\left.\times\tilde{I}_{000}(u,v,w,\tau)\tilde{I}_{010}(u,v,w,\tau)+\left[1+\varepsilon_{I,V}\,g_{I,V}(u,v,w,T)\right]\tilde{I}_{001}(u,v,w,\tau)\,\tilde{V}_{000}(u,v,w,\tau)\right\}\times$$
$$\times c_n(w)d\,w\,d\,v\,d\,u\,d\,\tau$$

$$\tilde{V}_{011}(\chi,\eta,\phi,\vartheta)=-2\sum_{n=1}^{\infty}c_n(\chi)c_n(\eta)c_n(\phi)e_{nV}(\vartheta)\int_0^{\vartheta}e_{nV}(-\tau)\int_0^1 c_n(u)\int_0^1 c_n(v)\int_0^1\left\{\left[1+\varepsilon_{V,V}\,g_{V,V}(u,v,w,T)\right]\times\right.$$

$$\times \tilde{V}_{000}(u,v,w,\tau)\tilde{V}_{010}(u,v,w,\tau)+\left[1+\varepsilon_{I,V}\,g_{I,V}(u,v,w,T)\right]\tilde{I}_{000}(u,v,w,\tau)\tilde{V}_{001}(u,v,w,\tau)\}\times$$
$$\times c_n(w)\,d\,w\,d\,v\,d\,u\,d\,\tau\,.$$

Inutial-order approximations of distributions of concentrations of complexes of radiation defects $\Phi_{\rho 0}(x,y,z,t)$, corrections for the approximations $\Phi_{\rho i}(x,y,z,t)$ $i\geq 1$, boundary and initial conditions for them

$$\frac{\partial \Phi_{I0}(x,y,z,t)}{\partial t}=D_{0\Phi I}\frac{\partial^2 \Phi_{I0}(x,y,z,t)}{\partial x^2}+D_{0\Phi I}\frac{\partial^2 \Phi_{I0}(x,y,z,t)}{\partial y^2}+D_{0\Phi I}\frac{\partial^2 \Phi_{I0}(x,y,z,t)}{\partial z^2}+$$
$$+k_{I,I}(x,y,z,T)I^2(x,y,z,t)-k_I(x,y,z,T)I(x,y,z,t)$$

$$\frac{\partial \Phi_{V0}(x,y,z,t)}{\partial t}=D_{0\Phi V}\frac{\partial^2 \Phi_{V0}(x,y,z,t)}{\partial x^2}+D_{0\Phi V}\frac{\partial^2 \Phi_{V0}(x,y,z,t)}{\partial y^2}+D_{0\Phi V}\frac{\partial^2 \Phi_{V0}(x,y,z,t)}{\partial z^2}+$$
$$+k_{V,V}(x,y,z,T)V^2(x,y,z,t)-k_V(x,y,z,T)V(x,y,z,t);$$

$$\frac{\partial \Phi_{Ii}(x,y,z,t)}{\partial t}=D_{0\Phi I}\frac{\partial^2 \Phi_{Ii}(x,y,z,t)}{\partial x^2}+D_{0\Phi I}\frac{\partial^2 \Phi_{Ii}(x,y,z,t)}{\partial y^2}+D_{0\Phi I}\frac{\partial^2 \Phi_{Ii}(x,y,z,t)}{\partial z^2}+$$
$$+D_{0\Phi I}\frac{\partial}{\partial x}\left[g_{\Phi I}(x,y,z,T)\frac{\partial \Phi_{Ii-1}(x,y,z,t)}{\partial x}\right]+D_{0\Phi I}\frac{\partial}{\partial y}\left[g_{\Phi I}(x,y,z,T)\frac{\partial \Phi_{Ii-1}(x,y,z,t)}{\partial y}\right]+$$
$$+D_{0\Phi I}\frac{\partial}{\partial z}\left[g_{\Phi I}(x,y,z,T)\frac{\partial \Phi_{Ii-1}(x,y,z,t)}{\partial z}\right]$$

$$\frac{\partial \Phi_{Vi}(x,y,z,t)}{\partial t}=D_{0\Phi V}\frac{\partial^2 \Phi_{Vi}(x,y,z,t)}{\partial x^2}+D_{0\Phi V}\frac{\partial^2 \Phi_{Vi}(x,y,z,t)}{\partial y^2}+D_{0\Phi V}\frac{\partial^2 \Phi_{Vi}(x,y,z,t)}{\partial z^2}+$$
$$+D_{0\Phi V}\frac{\partial}{\partial x}\left[g_{\Phi V}(x,y,z,T)\frac{\partial \Phi_{Vi-1}(x,y,z,t)}{\partial x}\right]+D_{0\Phi V}\frac{\partial}{\partial y}\left[g_{\Phi V}(x,y,z,T)\frac{\partial \Phi_{Vi-1}(x,y,z,t)}{\partial y}\right]+$$
$$+D_{0\Phi V}\frac{\partial}{\partial z}\left[g_{\Phi V}(x,y,z,T)\frac{\partial \Phi_{Vi-1}(x,y,z,t)}{\partial z}\right],\ i\geq 1;$$

$$\left.\frac{\partial \Phi_{\rho i}(x,y,z,t)}{\partial x}\right|_{x=0}=0,\ \left.\frac{\partial \Phi_{\rho i}(x,y,z,t)}{\partial x}\right|_{x=L_x}=0,\ \left.\frac{\partial \Phi_{\rho i}(x,y,z,t)}{\partial y}\right|_{y=0}=0,\ \left.\frac{\partial \Phi_{\rho i}(x,y,z,t)}{\partial y}\right|_{y=L_y}=0,$$
$$\left.\frac{\partial \Phi_{\rho i}(x,y,z,t)}{\partial z}\right|_{z=0}=0,\ \left.\frac{\partial \Phi_{\rho i}(x,y,z,t)}{\partial z}\right|_{z=L_z}=0,\ i\geq 0;\ \Phi_{\rho 0}(x,y,z,0)=f_{\Phi\rho}(x,y,z),\ \Phi_{\rho i}(x,y,z,0)=0,\ i\geq 1.$$

Solutions of the above equations could be written as

$$\Phi_{\rho 0}(x,y,z,t)=\frac{1}{L_xL_yL_z}+\frac{2}{L_xL_yL_z}\sum_{n=1}^{\infty}F_{n\Phi_\rho}c_n(x)c_n(y)c_n(z)e_{n\Phi_\rho}(t)+\frac{2}{L}\sum_{n=1}^{\infty}n\,c_n(x)\,c_n(y)c_n(z)\times$$
$$\times e_{\Phi_\rho n}(t)\int_0^t e_{\Phi_\rho n}(-\tau)\int_0^{L_x}c_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}\left[k_{I,I}(u,v,w,T)I^2(u,v,w,\tau)-k_I(u,v,w,T)I(u,v,w,\tau)\right]\times$$
$$\times c_n(w)d\,w\,d\,v\,d\,u\,d\tau\,,$$

where $F_{n\Phi_\rho}=\int\limits_0^{L_x}c_n(u)\int\limits_0^{L_y}c_n(v)\int\limits_0^{L_z}c_n(w)f_{\Phi_\rho}(u,v,w)\,d\,w\,d\,v\,d\,u$, $e_{n\Phi_\rho}(t)=\exp\left[-\pi^2n^2D_{0\Phi_\rho}t\left(\frac{1}{L_x^2}+\frac{1}{L_y^2}+\frac{1}{L_z^2}\right)\right]$,
$c_n(x)=cos(\pi nx/L_x)$;

$$\Phi_{\rho\,i}(x,y,z,t)=-\frac{2\pi}{L_x^2L_yL_z}\sum_{n=1}^{\infty}n\,c_n(x)\,c_n(y)\,c_n(z)\,e_{\Phi_\rho n}(t)\int\limits_0^t e_{\Phi_\rho n}(-\tau)\int\limits_0^{L_x}s_n(u)\int\limits_0^{L_y}c_n(v)\int\limits_0^{L_z}g_{\Phi_\rho}(u,v,w,T)\times$$
$$\times c_n(w)\frac{\partial\Phi_{I_\rho i-1}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\tau-\frac{2\pi}{L_xL_y^2L_z}\sum_{n=1}^{\infty}n\,c_n(x)c_n(y)c_n(z)e_{\Phi_\rho n}(t)\int\limits_0^t e_{\Phi_\rho n}(-\tau)\int\limits_0^{L_x}c_n(u)\times$$
$$\times\int\limits_0^{L_y}s_n(v)\int\limits_0^{L_z}c_n(w)g_{\Phi_\rho}(u,v,w,T)\frac{\partial\Phi_{I_\rho i-1}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\tau-\frac{2\pi}{L_xL_yL_z^2}\sum_{n=1}^{\infty}n\,c_n(x)c_n(y)c_n(z)\times$$
$$\times e_{\Phi_\rho n}(t)\int\limits_0^t e_{\Phi_\rho n}(-\tau)\int\limits_0^{L_x}c_n(u)\int\limits_0^{L_y}c_n(v)\int\limits_0^{L_z}s_n(w)\frac{\partial\Phi_{I_\rho i-1}(u,v,w,\tau)}{\partial w}\;g_{\Phi_\rho}(u,v,w,T)\,d\,w\,d\,v\,d\,u\,d\tau\text{ , } i\ge 1,$$

where $s_n(x)=sin(\pi nx/L_x)$.

Equation for initial-order approximation of dopant concentration $C_{00}(x,t)$, corrections for the approximation $C_{ij}(x,y,z,t)$ ($i\ge 1$, $j\ge 1$), boundary and initial conditions of the above functions are

$$\frac{\partial C_{00}(x,y,z,t)}{\partial t}=D_{0L}\frac{\partial^2C_{00}(x,y,z,t)}{\partial x^2}+D_{0L}\frac{\partial^2C_{00}(x,y,z,t)}{\partial y^2}+D_{0L}\frac{\partial^2C_{00}(x,y,z,t)}{\partial z^2};$$

$$\frac{\partial C_{i0}(x,y,z,t)}{\partial t}=D_{0L}\left[\frac{\partial^2C_{i0}(x,y,z,t)}{\partial x^2}+\frac{\partial^2C_{i0}(x,y,z,t)}{\partial y^2}+\frac{\partial^2C_{i0}(x,y,z,t)}{\partial z^2}\right]+$$
$$+D_{0L}\frac{\partial}{\partial x}\left[g_L(x,y,z,T)\frac{\partial C_{i-10}(x,y,z,t)}{\partial x}\right]+D_{0L}\frac{\partial}{\partial y}\left[g_L(x,y,z,T)\frac{\partial C_{i-10}(x,y,z,t)}{\partial y}\right]+$$
$$+D_{0L}\frac{\partial}{\partial z}\left[g_L(x,y,z,T)\frac{\partial C_{i-10}(x,y,z,t)}{\partial z}\right],\; i\ge 1;$$

$$\frac{\partial C_{01}(x,y,z,t)}{\partial t}=D_{0L}\left[\frac{\partial^2C_{01}(x,y,z,t)}{\partial x^2}+\frac{\partial^2C_{01}(x,y,z,t)}{\partial y^2}+\frac{\partial^2C_{01}(x,y,z,t)}{\partial z^2}\right]+\left\{\frac{\partial}{\partial x}\left[\frac{C_{00}^{\gamma}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\times\right.\right.$$
$$\left.\left.\times\frac{\partial C_{00}(x,y,z,t)}{\partial x}\right]+\frac{\partial}{\partial y}\left[\frac{C_{00}^{\gamma}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{00}(x,y,z,t)}{\partial y}\right]+\frac{\partial}{\partial z}\left[\frac{C_{00}^{\gamma}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{00}(x,y,z,t)}{\partial z}\right]\right\}D_{0L};$$

$$\frac{\partial C_{02}(x,y,z,t)}{\partial t}=D_{0L}\left[\frac{\partial^2C_{02}(x,y,z,t)}{\partial x^2}+\frac{\partial^2C_{02}(x,y,z,t)}{\partial y^2}+\frac{\partial^2C_{02}(x,y,z,t)}{\partial z^2}\right]+\left[\frac{C_{00}^{\gamma-1}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\times\right.$$
$$\left.\times C_{01}(x,y,z,t)\frac{\partial C_{00}(x,y,z,t)}{\partial x}\right]+\frac{\partial}{\partial y}\left[C_{01}(x,y,z,t)\frac{C_{00}^{\gamma-1}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{00}(x,y,z,t)}{\partial y}\right]+$$
$$\left.+\frac{\partial}{\partial z}\left[C_{01}(x,y,z,t)\frac{C_{00}^{\gamma-1}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{00}(x,y,z,t)}{\partial z}\right]\right\}D_{0L}+\left\{\frac{\partial}{\partial x}\left[\frac{C_{00}^{\gamma}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{01}(x,y,z,t)}{\partial x}\right]\times\right.$$

$$+\frac{\partial}{\partial y}\left[\frac{C_{00}^{\gamma}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{01}(x,y,z,t)}{\partial y}\right]+\frac{\partial}{\partial z}\left[\frac{C_{00}^{\gamma}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{01}(x,y,z,t)}{\partial z}\right]\Bigg\}D_{0L};$$

$$\frac{\partial C_{11}(x,y,z,t)}{\partial t}=D_{0L}\left[\frac{\partial^2 C_{11}(x,y,z,t)}{\partial x^2}+\frac{\partial^2 C_{11}(x,y,z,t)}{\partial y^2}+\frac{\partial^2 C_{11}(x,y,z,t)}{\partial z^2}\right]+\left\{\frac{\partial}{\partial x}\left[\frac{C_{00}^{\gamma-1}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\times\right.\right.$$

$$\left.\times C_{10}(x,y,z,t)\frac{\partial C_{00}(x,y,z,t)}{\partial x}\right]+\frac{\partial}{\partial y}\left[C_{10}(x,y,z,t)\frac{C_{00}^{\gamma-1}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{00}(x,y,z,t)}{\partial y}\right]+$$

$$+\frac{\partial}{\partial z}\left[C_{10}(x,y,z,t)\frac{C_{00}^{\gamma-1}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{00}(x,y,z,t)}{\partial z}\right]\Bigg\}D_{0L}+D_{0L}\left\{\frac{\partial}{\partial x}\left[\frac{\partial C_{10}(x,y,z,t)}{\partial x}\times\right.\right.$$

$$\left.\times\frac{C_{00}^{\gamma}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\right]+\frac{\partial}{\partial y}\left[\frac{C_{00}^{\gamma}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{10}(x,y,z,t)}{\partial y}\right]+\frac{\partial}{\partial z}\left[\frac{C_{00}^{\gamma}(x,y,z,t)}{P^{\gamma}(x,y,z,T)}\frac{\partial C_{10}(x,y,z,t)}{\partial y}\right]\Bigg\}+$$

$$+D_{0L}\left\{\frac{\partial}{\partial x}\left[g_L(x,y,z,T)\frac{\partial C_{01}(x,y,z,t)}{\partial x}\right]+\frac{\partial}{\partial y}\left[g_L(x,y,z,T)\frac{\partial C_{01}(x,y,z,t)}{\partial y}\right]+\right.$$

$$\left.+\frac{\partial}{\partial z}\left[g_L(x,y,z,T)\frac{\partial C_{01}(x,y,z,t)}{\partial z}\right]\right\};$$

$$\left.\frac{\partial C_{ij}(x,y,z,t)}{\partial x}\right|_{x=0}=0,\ \left.\frac{\partial C_{ij}(x,y,z,t)}{\partial x}\right|_{x=L_x}=0,\ \left.\frac{\partial C_{ij}(x,y,z,t)}{\partial y}\right|_{y=0}=0,\ \left.\frac{\partial C_{ij}(x,y,z,t)}{\partial y}\right|_{y=L_y}=0,$$

$$\left.\frac{\partial C_{ij}(x,y,z,t)}{\partial z}\right|_{z=0}=0,\ \left.\frac{\partial C_{ij}(x,y,z,t)}{\partial z}\right|_{z=L_z}=0,\ i\geq 0,\ j\geq 0;$$

$$C_{00}(x,y,z,0)=f_C(x,y,z),\ C_{ij}(x,y,z,0)=0,\ i\geq 1,\ j\geq 1.$$

Solutions of the above equations with account boundary and initial conditions could be written as

$$C_{00}(x,y,z,t)=\frac{1}{L_xL_yL_z}+\frac{2}{L_xL_yL_z}\sum_{n=1}^{\infty}F_{nC}c_n(x)c_n(y)c_n(z)e_{nC}(t),$$

where $e_{nC}(t)=\exp\left[-\pi^2n^2D_{0C}t\left(\frac{1}{L_x^2}+\frac{1}{L_y^2}+\frac{1}{L_z^2}\right)\right]$, $F_{nC}=\int_0^{L_x}c_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}c_n(w)\,f_C(u,v,w)\,d\,w\,d\,v\,d\,u$;

$$C_{i0}(x,y,z,t)=-\frac{2\pi}{L_x^2L_yL_z}\sum_{n=1}^{\infty}n\,F_{nC}c_n(x)c_n(y)c_n(z)e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}s_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}g_L(u,v,w,T)\times$$

$$\times c_n(w)\frac{\partial C_{i-10}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_xL_y^2L_z}\sum_{n=1}^{\infty}n\,F_{nC}c_n(x)c_n(y)c_n(z)e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}c_n(u)\times$$

$$\times\int_0^{L_y}s_n(v)\int_0^{L_z}c_n(v)\,g_L(u,v,w,T)\frac{\partial C_{i-10}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_xL_yL_z^2}\sum_{n=1}^{\infty}n\,F_{nC}c_n(x)c_n(y)c_n(z)\times$$

$$\times e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}c_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}s_n(v)\,g_L(u,v,w,T)\frac{\partial C_{i-10}(u,v,w,\tau)}{\partial w}d\,w\,d\,v\,d\,u\,d\,\tau,\ i\geq 1;$$

$$C_{01}(x,y,z,t)=-\frac{2\pi}{L_x^2L_yL_z}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}s_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}\frac{C_{00}^{\gamma}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\times$$

$$\times\,c_n(w)\frac{\partial C_{00}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_xL_y^2L_z}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}c_n(u)\times$$

$$\times\int_0^{L_y}s_n(v)\int_0^{L_z}c_n(w)\frac{C_{00}^{\gamma}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{00}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_xL_yL_z^2}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\times$$

$$\times\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}c_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}s_n(w)\frac{C_{00}^{\gamma}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{00}(u,v,w,\tau)}{\partial w}d\,w\,d\,v\,d\,u\,d\,\tau;$$

$$C_{02}(x,y,z,t)=-\frac{2\pi}{L_x^2L_yL_z}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}s_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}C_{01}(u,v,w,\tau)\times$$

$$\times\,c_n(w)\frac{C_{00}^{\gamma-1}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{00}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_xL_y^2L_z}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\times$$

$$\times\int_0^t e_{nC}(-\tau)\int_0^{L_x}c_n(u)\int_0^{L_y}s_n(v)\int_0^{L_z}c_n(w)\,C_{01}(u,v,w,\tau)\frac{C_{00}^{\gamma-1}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{00}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-$$

$$-\frac{2\pi}{L_xL_yL_z^2}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}c_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}s_n(w)\frac{\partial C_{00}(u,v,w,\tau)}{\partial w}\times$$

$$\times\,C_{01}(u,v,w,\tau)\frac{C_{00}^{\gamma-1}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_x^2L_yL_z}\sum_{n=1}^{\infty}F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\times$$

$$\times\,n\int_0^{L_x}s_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}C_{01}(u,v,w,\tau)\frac{C_{00}^{\gamma-1}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{00}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_xL_yL_z^2}\sum_{n=1}^{\infty}F_{nC}\times$$

$$\times\,n\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}c_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}C_{01}(u,v,w,\tau)\frac{C_{00}^{\gamma-1}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{00}(u,v,w,\tau)}{\partial w}\times$$

$$\times\,s_n(w)\,d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_x^2L_yL_z}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}s_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}c_n(w)\times$$

$$\times\frac{C_{00}^{\gamma}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{01}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_xL_y^2L_z}\sum_{n=1}^{\infty}F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\times$$

$$\times\,n\int_0^{L_x}c_n(u)\int_0^{L_y}s_n(v)\int_0^{L_z}c_n(w)\frac{C_{00}^{\gamma}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{01}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_xL_yL_z^2}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\times$$

$$\times\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}c_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}s_n(w)\frac{C_{00}^{\gamma}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{01}(u,v,w,\tau)}{\partial w}d\,w\,d\,v\,d\,u\,d\,\tau;$$

$$C_{11}(x,y,z,t)=-\frac{2\pi}{L_x^2L_yL_z}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}s_n(u)\int_0^{L_y}c_n(v)\int_0^{L_z}g_L(u,v,w,T)\times$$

$$\times\,c_n(w)\frac{\partial C_{01}(u,v,w,\tau)}{\partial u}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_xL_y^2L_z}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\,e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x}c_n(u)\times$$

$$\times\int_0^{L_y}s_n(v)\int_0^{L_z}c_n(w)\,g_L(u,v,w,T)\frac{\partial C_{01}(u,v,w,\tau)}{\partial v}d\,w\,d\,v\,d\,u\,d\,\tau-\frac{2\pi}{L_xL_yL_z^2}\sum_{n=1}^{\infty}n\,F_{nC}\,c_n(x)\,c_n(y)\,c_n(z)\times$$

$$\times e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x} c_n(u)\int_0^{L_y} c_n(v)\int_0^{L_z} s_n(w)\; g_L(u,v,w,T)\frac{\partial C_{01}(u,v,w,\tau)}{\partial w} d\,w\,d\,v\,d\,u\,d\,\tau - \frac{2\pi}{L_x^2 L_y L_z}\times$$

$$\times \sum_{n=1}^{\infty} n\,F_{nC} c_n(x)\; e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x} s_n(u)\int_0^{L_y} c_n(v)\int_0^{L_z} c_n(w)\frac{C_{00}^{\gamma}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{10}(u,v,w,\tau)}{\partial u} d\,w\,d\,v\,d\,u\,d\,\tau \times$$

$$\times c_n(y)c_n(z) - \frac{2\pi}{L_x L_y^2 L_z}\sum_{n=1}^{\infty} n\,c_n(x)c_n(y)c_n(z)e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x} c_n(u)\int_0^{L_y} s_n(v)\int_0^{L_z} c_n(w)\frac{C_{00}^{\gamma}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\times$$

$$\times F_{nC}\frac{\partial C_{10}(u,v,w,\tau)}{\partial v} d\,w\,d\,v\,d\,u\,d\,\tau - \frac{2\pi}{L_x L_y L_z^2}\sum_{n=1}^{\infty} n\,F_{nC} c_n(x)c_n(y)c_n(z)e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x} c_n(u)\times$$

$$\times \int_0^{L_y} c_n(v)\int_0^{L_z} s_n(w)\frac{C_{00}^{\gamma}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{10}(u,v,w,\tau)}{\partial w}\; d\,w\,d\,v\,d\,u\,d\,\tau - \frac{2\pi}{L_x^2 L_y L_z}\sum_{n=1}^{\infty} n\,F_{nC} c_n(x)c_n(y)c_n(z)\times$$

$$\times e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x} s_n(u)\int_0^{L_y} c_n(v)\int_0^{L_z} c_n(w)C_{10}(u,v,w,\tau)\frac{C_{00}^{\gamma-1}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{00}(u,v,w,\tau)}{\partial u} d\,w\,d\,v\,d\,u\,d\,\tau -$$

$$-\frac{2\pi}{L_x L_y^2 L_z}\sum_{n=1}^{\infty} c_n(x)\; c_n(y)c_n(z)e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x} c_n(u)\int_0^{L_y} s_n(v)\int_0^{L_z} c_n(w)\frac{C_{00}^{\gamma-1}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{00}(u,v,w,\tau)}{\partial v}\times$$

$$\times n\; C_{10}(u,v,w,\tau) d\,w\,d\,v\,d\,u\,d\,\tau\, F_{nC} - \frac{2\pi}{L_x L_y L_z^2}\sum_{n=1}^{\infty} n\,c_n(x)c_n(y)c_n(z)e_{nC}(t)\int_0^t e_{nC}(-\tau)\int_0^{L_x} c_n(u)\int_0^{L_y} c_n(v)\times$$

$$\times F_{nC}\int_0^{L_z} s_n(w)C_{10}(u,v,w,\tau)\frac{C_{00}^{\gamma-1}(u,v,w,\tau)}{P^{\gamma}(u,v,w,T)}\frac{\partial C_{00}(u,v,w,\tau)}{\partial w} d\,w\,d\,v\,d\,u\,d\,\tau\,.$$

Short Biographies:

Pankratov Evgeny Leonidovich was born at 1977. From 1985 to 1995 he was educated in a secondary school in Nizhny Novgorod. From 1995 to 2004 he was educated in Nizhny Novgorod State University: from 1995 to 1999 it was bachelor course in Radiophysics, from 1999 to 2001 it was master course in Radiophysics with specialization in Statistical Radiophysics, from 2001 to 2004 it was PhD course in Radiophysics. From 2004 to 2008 E.L. Pankratov was a leading technologist in Institute for Physics of Microstructures. From 2008 to 2012 E.L. Pankratov was a senior lecture/Associate Professor of Nizhny Novgorod State University of Architecture and Civil Engineering. Now E.L. Pankratov is in his Full Doctor course in Radiophysical Department of Nizhny Novgorod State University. He has 96 published papers in area of his researches.

Bulaeva Elena Alexeevna was born at 1991. From 1997 to 2007 she was educated in secondary school of village Kochunovo of Nizhny Novgorod region. From 2007 to 2009 she was educated in boarding school "Center for gifted children". From 2009 she is a student of Nizhny Novgorod State University of Architecture and Civil Engineering (spatiality "Assessment and management of real estate"). At the same time she is a student of courses "Translator in the field of professional communication" and "Design (interior art)" in the University. E.A. Bulaeva was a contributor of grant of President of Russia (grant № MK-548.2010.2). She has 29 published papers in area of her researches.