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THE MODELING OF LIGHTING-EMITTING DIODES DISPOSITION FOR OBTAINING MORE CONSTANT TEMPERATURE REGIME

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In our days the most of electric energy, which is used in lighting can be saved by swiching to efficient and cold solid-state lighting sources. The creation of efficient sources of white light is the ultimate goal of the solid-state lighting technology [1]. These polychromatic solid-state lamps that produces white light by additive mixing of the emissions from primary colored light emitting diodes are used for traffic lights, road signs, automobile taillight, outdoor displays and so on.

Optimal solid-state lamps composed of few different light-emitting diodes (LED) are analysed in our presentation. The mathematical model for one LED can be described by the heat equations system ($t > 0$):

$$\frac{\partial u}{\partial t} = D_1 \left(\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial u}{\partial r}\right) + \frac{\partial}{\partial z}\left(\frac{\partial u}{\partial z}\right)\right),$$

$$\Omega_1 = \{0 < r < r_1, 0 < z < z_1\}, \Omega_2 = \{r_1 < r < r_2, 0 < z < z_2\}, \tag{1}$$

$$\frac{\partial u}{\partial t} = D_2 \left(\frac{1}{r}\frac{\partial}{\partial r}\left(r\frac{\partial u}{\partial r}\right) + \frac{\partial}{\partial z}\left(\frac{\partial u}{\partial z}\right)\right) + F, \Omega_3 = \{0 < r < r_1, z_1 < z < z_2\}, \tag{2}$$

$$u(0, r, z) = 0, \overline{\Omega} = \overline{\Omega_1} \cup \overline{\Omega_2} \cup \overline{\Omega_3}, \tag{3}$$

$$\left.\frac{\partial u}{\partial r}\right|_{\substack{r=r_2\\0<z<z_2}} = 0, \left.\frac{\partial u}{\partial z}\right|_{\substack{z=z_2\\0<r<r_1}} = 0, \left.\frac{\partial u}{\partial r}\right|_{\substack{r=0\\0<z<z_2}} = 0, \tag{4}$$

$$\left.\frac{\partial u}{\partial z}\right|_{\substack{z=z_2\\r_1<r<r_2}} = -\gamma_1 \cdot \left(u^4 - u_k^4\right), \left.\frac{\partial u}{\partial z}\right|_{\substack{z=0\\0<r<r_2}} = \gamma_2 \cdot \left(u^4 - u_k^4\right), \tag{5}$$

$$D_2 \left.\frac{\partial u}{\partial z}\right|_{\substack{z=z_1\\0<r<r_1}} = D_1 \left.\frac{\partial u}{\partial z}\right|_{\substack{z=z_1\\0<r<r_1}}, D_2 \left.\frac{\partial u}{\partial r}\right|_{\substack{r=r_1\\z_1<z<z_2}} = D_1 \left.\frac{\partial u}{\partial r}\right|_{\substack{r=r_1\\z_1<z<z_2}}, \tag{6}$$

where r and z cilyndrical space coordinates, $t-$ time, $u(t, r, z)-$ temperature distribution, D_1, D_2 are the diffusion coefficients, $F-$ the lighting source, γ_1, γ_2- are the emission coefficients.

The problem (1)-(6) was solved numerically by applying the finite difference technique [2]. Using computer simulation, the model of few LEDs, where a lot of attention was paid to the LEDs disposition to get more constant temperature regime, was investigated.

REFERENCES

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