TWIST–DEFORMATION OF NEMATICS WITH NEGATIVE DIAMAGNETIC ANISOTROPY IN MAGNETIC FIELD ARBITRARY ORIENTATION

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Within the limits of standart standard equations of nematodynamics in the linear approximation the task of reorientation of a nematics with negative diamagnetic anisotropy (χ_a<0) in the magnetic field of arbitrary orientation relating to director $\vec{n}$ has been solved.

The director $\vec{n}$ field in a planar layer of the nematics of thickness *d* is disturbed by magnetic field $\vec{H}$, the direction of the latter making an arbitrary angle β with director $\vec{n}_0$ initial direction parallel to axis *X*. As a result the director field distortion takes place that conforms to the director turn to a certain angle *θ*. T–deformation of the nematics layer along axis *Z* occurs.

The director field distortion along axis *Z* is presented as follows and vector $\vec{H}$ in projection on to the coordinate axes, accordingly,

$$\vec{n} \equiv (n_x, n_y, n_z) = (\cos\theta, \sin\theta, 0), \ \vec{H} \equiv (H\cos\beta, -H\sin\beta, 0).$$

Besides, it is considered that

$$\partial x/\partial t = \partial y/\partial t = \partial z/\partial t = 0 \ \text{and} \ \partial\theta/\partial x = \partial\theta/\partial y = 0.$$

For the geometry in consideration on equation of moments for the director in the linear approximation in projection on to Decart coordinate system axes is written as follows

$$\partial^2\theta/\partial z^2 + a\theta + c = b\,\partial\theta/\partial t, \tag{1}$$

where K_{22} – constant elasticity twisting, γ_1 – rotational viscosity constant,

$$a = (|\chi_a|H^2/K_{22})\cos 2\beta, \ b = \gamma_1/K_{22}, \ c = (|\chi_a|H^2/2K_{22})\sin 2\beta. \tag{2}$$

The boundary condition and the initial conditions of the task are written as:

$$\theta|_{z=\pm d/2} = 0, \ \theta|_{t=0} = 0, \ \partial\theta/\partial z|_{z=0} = 0.$$

Equation (1) is solved by Laplas method. The solution of equation (1) taking account markings (2) is the function

$$\theta(z,t) = \frac{4bc}{\pi}\sum_{m=1}^{\infty}\frac{\exp\{[a-(\pi^2(2m-1)^2/d^2)]b^{-1}t\}}{(-1)^{m-1}(2m-1)[a-(\pi^2(2m-1)^2/d^2)]}\cos[\pi(2m-1)z/d] + cP(z), \tag{3}$$

where

$$P(z) = \frac{[((d/2)^2 - z^2)/2!] - a[((d/2)^4 - z^4)/4!] + a^2[((d/2)^6 - z^6)/6!] - \ldots}{1 - [a(d/2)^2/2!] + [a(d/2)^4/4!] - [a(d/2)^6/6!] + \ldots}.$$

Existence of critical field follows from (3) its value is determined by equation [1]:

$$H_C = \sqrt{\pi^2 K_{22}/(d^2|\chi_a|\cos 2\beta)}.$$

References

(1) A. Golovanov et al., *Ultrasound and thermodynamic properties substance*, Scientific proceedings collection, Kursk, **2002**, p. 5.