Actuator for Nano biomedical Research

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Abstract
In this work, we obtain the parameters of the actuator for nano biomedical research. We have mathematical model of the actuator with the piezoelectric or magnetostrictive effect.

Keywords: Piezoelectric actuator, Magnetostrictive actuator, Electromechanics, Parameter.

Introduction
Actuator for nano biomedical research is used to nanomanipulations in the scanning microscope, the nanoliter pump, the gene manipulator, the cell penetration tool, the microsurgery [1–16]. We obtain the transfer functions and the characteristics of the actuators on the piezoelectric and magnetostrictive effect for control system of the nano deformation for nano biomedical research [17–28].

Transfer function
The equation of electromechanics [8, 11] for relative deformation $S_i$ of the piezoelectric or magnetostrictive actuator has the form

$$S_i = v_m \Psi_m + s_{ij}^T T_j$$

where $v_m, \Psi_m, s_{ij}^T, T_j$ are the module, the control parameter, the elastic compliance and the mechanical stress, and $i,j,m$ are the indexes. We have the second order differential equation [12-15]. In result we have the mathematical model and the scheme of the actuator for nano biomedical research on Figure 1 with the piezoelectric or magnetostrictive effect in the form

$$W(p) = \Xi(p) / \Psi(p)$$

where $\Xi(p),\Psi(p)$ are transforms of Laplace the displacement and the control parameter, $p, \gamma, \chi$ are the conversion parameter, the propagation coefficient, the coordinate.

We drew model of the actuator from decision the equation of electromechanics and the second order differential equation [12-15]. In result we have the mathematical model and the scheme of the actuator for nano biomedical research on Figure 1 with the piezoelectric or magnetostrictive effect in the form

$$W(p) = \Xi(p) / \Psi(p)$$

and the control parameter, $p, \gamma, \chi$ are the conversion parameter, the propagation coefficient, the coordinate.

We receive the transfer function of the transverse piezoelectric actuator in the form

$$W(p) = \Xi(p) / \Psi(p)$$

At $d_31 = 2 \times 10^{-10} \text{m/V}, \delta = 20, \chi = 50 \text{V}, M_z = 4 \text{ kg}, C_{zz} = 2 \times 10^{-7} \text{N/m}, C_{ix} = 0.5 \times 10^{-7} \text{N/m} we obtain the parameters of actuator $k_z = 3.2 \text{ nm/V}, \xi_z(x) = 160 \text{ nm}, T_z = 0.4 \times 10^{-3} \text{s}$.
Conclusion

In this work, we receive the transfer functions and the parameters of the actuator for the control system of the nano deformation for nano biomedical research. We obtain the mathematical model of the actuator from decision the equation of electromechanics and the second order differential equation.

References


