OPTIMAL GEOMETRICAL PARAMETERS OF THE PIEZOELECTRIC BIMORPHS FOR LASER SHUTTER SYSTEMS

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Introduction. Laser technologies are widely used in modern devices and equipment. One of the common problems is controlling the intensity of laser beam power up to zero, realized by various laser beam shutters for safety and beam control applications. In this paper the authors investigate dependence of dynamic characteristics of piezoelectric bimorph actuator, used in high speed laser shutter, on its geometrical parameters. Authors analyze the change of amplitude and resonant frequency when geometrical form of the bimorph is modified. The optimal form of bimorph piezoelectric actuator was established using both theoretical calculations and experiment results.

Investigated laser beam shutter and working principle. Investigated piezoelectric laser beam shutter consists of the bimorph type piezoelectric actuator and special plate for the beam shutting. Bending deformations of bimorph can be effected by using the piezoelectric plate; the direction of deformation and deformation rate depend on materials used in actuator, polarization direction and electric field.

Bimorphs used in design of laser beam shutting system. The purpose of this investigation is to find optimal geometrical parameters of bimorph transducer with the aim to reach operating bandwidth as wide as possible. Bandwidth depends on resonant frequency of the first bending form of actuator, so it is very important to relate actuator's geometric parameters with the first resonant frequency and specified amplitude of oscillation. In that case the design of piezoelectric shutter would be rational and consistent with the technical characteristics of the system.

Calculations and experiments were made for three cases: when ratios of the width of ends of the actuator were 1:1 ($b = a$), 1:2 ($b = a/2$) and 1:3 ($b = a/3$).

Conclusion. The design and analysis of the piezoelectric bimorph actuator for the laser beam shutter systems was presented. Influence of the geometric parameters and form of the piezoelectric bimorph on the resonant frequency of the actuator was determined. Modal frequency and harmonic response analysis based on FEM and experimental studies of the actuator have been carried out.

Literature

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