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Nonlinear dynamics of Euler-Bernoulli nanobeams in temperature/magnetic fields and under radiation with an account of physical nonlinearity

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Abstract: The theory of nonlinear dynamics of Euler-Bernoulli nano beams taking into account the inhomogeneity of the material in temperature/magnetic fields and subjected to radiation exposure is proposed. In order to construct this theory, the following hypotheses are introduced: (i) the beam material is isotropic, but non-uniform; (ii) modulus of elasticity E(x,z,e_i,T) and Poisson's ratio v(x,z,e_i,T) depend on coordinates and strain intensity; (iii) strain rate depends on temperature and radiation exposure; (iv) kinematic model of the first approximation (Euler-Bernoulli) is employed; (v) physical nonlinearity is taken into account according to the deformation theory of plasticity; (vi) nanostructures are taken into account according to the modified couple stress theory; (vii) the stationary temperature field is determined from the solution of the two-dimensional heat conduction equation (Poisson's equation) taking into account the internal heat sources for the boundary conditions of the first to the third kind; (viii) the magnetic field is determined by solving a Maxwell equation. The nonlinear dynamics and statics of Euler-Bernoulli nanobeams are analyzed depending on the intensity and type of temperature and magnetic fields, the intensity of radiation and the size-dependent parameter. A static solution is obtained from a dynamic solution by means of a continuation method with regard to a parameter.

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