

Free Vibration Characteristics of Nanoplates with Various Edge Supports Incorporating Surface Free Energy Effects

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Abstract : Due to size-dependent behavior of nanostructures, the classical continuum models are not applicable for the analyses at this submicron size. Surface stress effect is one of the most important matters which make the nanoscale structures to have different properties compared to the conventional structures due to high surface to volume ratio. In the present study, free vibration characteristics of nanoplates are investigated including surface stress effects. To this end, non-classical plate model based on Gurtin-Murdoch elasticity theory is proposed to evaluate the surface stress effects on the vibrational behavior of nanoplates subjected to different boundary conditions. Generalized differential quadrature (GDQ) method is employed to discretize the governing non-classical differential equations along with various edge supports. Selected numerical results are given to demonstrate the distinction between the behavior of nanoplates predicted by the classical and present non-classical plate models that leads to illustrate the great influence of surface stress effect. It is observed that this influence quite depends on the magnitude of the surface elastic constants which are relevant to the selected material.

Keywords : nanomechanics, surface stress, free vibration, GDQ method, small scale effect

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