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A new type epoxy-resin thermoelastic composite with dispersed PZT particlelayers in piezo-control forced vibrations

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Abstract

An analytical solution is developed in the forced and free vibration control for a new type epoxy-resin composite plate with integrated thermopiezoelectric and dispersed PZT particle layers. The finite element formulation for composite structures, which comprises material with different mix ratio of the epoxy resin and multi-wall carbon nanotube, is developed based on the shear deformation theory. The base formulation of a dynamic system is decoupled in modal form and the modal control forces are designed as linear shape function, so that there is no coupling between the modes due to feedback control. The numerical results show the effectiveness of various thermal loads and axial force on composite plate with different gain values in the forced vibration control. It is found that the loss factor significantly increase as the volume fraction of CNT rise up to 20 vol% and the damping capacity is improved in the vibration system. Thus an optimum formulation for the proper choice of weighting parameters, thermal environment, external load and material structure can be designed in the vibration feedback control system.

Key words: *Thermopiezoelectirc, Dispersed PZT particles, Piezo-control, Epoxy resin*

1. Introduction

Recent advance in design and manufacturing technologies have greatly enhanced the use of reinforced composite materials for aircraft and aerospace structural applications. With the proper selection and placement of piezo-patches, it is feasible to provide flexible force on a host structure to optimize its excitation performance. Advanced composite structures have attracted significant attention in the field of control and dynamics, and many achievements have been made in the past decade. Application of smart structures to vibration control may be traced to Baily and Hubbard (1995). Ha and coworkers (2002) developed a three-dimensional composite finite element method for modeling the dynamic and static response of laminate structures containing piezoelectric sensors and actuators. Since then, numerous investigators

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