Thermo elastic analysis of functionally graded rotating disks with temperature-dependent material properties: uniform and variable thickness.

ABSTRACT

A thermo elastic analysis is presented for axisymmetric rotating disks made of functionally graded material (FGM) with variable thickness. Material properties are assumed to be temperature-dependent and graded in the radial direction according to a grading index power law distribution. The temperature field considered is assumed to be uniformly distributed over the disk surface and varied in the radial direction. Semi-analytical solutions for the displacement field are given for solid disk and annular disk under free-free and fixed-free boundary conditions. The effects of the thermal field, the material grading index and the geometry of the disk on the displacement and stress fields are investigated. Results of this study emphasize on the crucial role of the temperature-dependent properties in a high temperature environment. A comparison of these results with the reported ones in the literature that is temperature-dependent versus temperature-independent suggests that a functionally graded rotating disk with concave thickness profile can work more efficiently than the one with uniform thickness irrespective of whether the material properties are assumed to be temperature-dependent or temperature-independent.

Keyword: Functionally graded material; Rotating disk; Temperature-dependent properties; Thermo elasticity.