THERMOMECHANICAL RESPONSE OF FUNCTIONALLY GRADED STRUCTURES

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ABSTRACT

Functionally gradient materials (FGM) are a class of composites that have a gradual variation of material properties from one surface to another. These novel materials were proposed as thermal barrier materials for applications in space planes, space structures, nuclear reactors, turbine rotors, flywheels, and gears, to name only a few. As conceived and manufactured today, these materials are isotropic and nonhomogeneous Two-constituent FGMs are usually made of a mixture of ceramic and metals for use in thermal environments. The ceramic constituent of the material provides the high temperature resistance due to its low thermal conductivity. The ductile metal constituent, on the other hand, prevents fracture due to high temperature gradient ina very short period of time. Typical situations where thermal shock occurs are during reentry of space vehicles, where the temperature changes from 273^{o}C to about 1,100^{o}C in a few minutes, and the advanced gas turbine, wherein a severe temperature transient of a change in temperature of 1,500^{o}C occurs over a time period of 15 s. The present lecture is an overview of the recent developments in the numerical modeling of functionally graded structures [1-5]. The lecture will present detailed discussion of the influence of geometric nonlinearity and temperature-dependent material properties on the response of functionally graded structures.

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