



First Laureate Fundamental Research



Project Title: Analysis of structures made of Functionally Graded Materials

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Abstract:

Functionally Graded Materials (FGMs) are new advance materials, microscopically homogeneous, in which the mechanical properties vary smoothly and continuously from one surface to the other. This is achieved by gradually varying the volume fraction of the constituent materials. These novel materials were first introduced by a group of scientists in Sendai, Japan in 1984. Typically, these materials are made from a mixture of ceramic and metal. The ceramic constituent of the material provides the high – temperature resistance due to its low thermal conductivity. The ductile metal constituent provides the necessary structural flexibility. Furthermore, a mixture of ceramic and metal with a continuously varying volume fraction can be easily manufactured. This eliminates interface problems of composite materials and thus the stress distributions are smooth. FGMs were initially designed as thermal barrier materials for various structures.

The advantage to use these materials is that they are able to withstand ultrahigh temperatures and extremely large temperature gradients, while they are corrosion and erosion resistant and have high fracture stiffness. These materials are now developed for general use as structural elements in extremely high temperature environments. Proper variation of the constituent materials in FGMs may provide an optimum structural design problems, where stress is either minimized or made to have the desired profile.