Scientific research on functionally graded materials (FGMs) considers, in a large sense, functions of gradients in materials comprising thermodynamic, mechanical, chemical, optical, electromagnetic, and/or biological aspects. In essence, FGMs are characterized by spatially varied microstructures created by non-uniform distributions of the reinforcement phase with different properties, sizes and shapes, as well as by interchanging the role of reinforcement and matrix materials in a continuous manner, as illustrated by Figs. 1 and 2. The second figure shows an example of a large-bulk ceramic/metal engineering FGM. This new concept of engineering the material microstructure marks the beginning of a paradigm shift in the way we think about materials and structures as it allows one, due to recent advances in material processing, to fully integrate material and structural design considerations.

In the present edition, a collection of technical papers is presented that represents current research interests with regard to the fracture behavior of FGMs. The papers include a balance amongst theoretical, computational, and experimental techniques. All the participants have contributed to advancing the state of knowledge in FGMs, and this special issue demonstrates that our understanding of fracture of FGMs is becoming increasingly clear. However, it also indicates areas for further development, such as constraint
effects full (i.e. for the entire range of material composition) experimental characterization of engineering FGMs under static and dynamic loading, development of fracture criteria with predictive capability, multiphysics and multiscale (space and time) failure considerations, and connection of research with industrial applications. In fact, this latter aspect needs to be emphasized so that FGMs can find wide use in engineering applications.

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