Mechanics Research Communications 78 (2016) 1

Contents lists available at ScienceDirect

Mechanics Research Communications

journal homepage: www.elsevier.com/locate/mechrescom

Multiscale, Multifunctional and Functionally Graded Materials (MM&FGM) Editorial

Functionally Graded Materials (FGMs) display continuous spatial variations in composition and microstructure for the specific purpose of adjusting their thermal, structural, mechanical, biological or functional response to specific application conditions. They are characterized by spatially varying 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 fashion. These multi-phase material systems cover a range of scales in space and time, and are best understood through a comprehensive multiphysics and multiscale approach. These materials have a wide range of applications including, for example, biomedical, automotive, aerospace, mechanical, civil, nuclear, and naval engineering. New applications are continually being discovered and developed.

Several of the papers in this special issue were originated from presentations at the "13th International Symposium on Multiscale, Multifunctional and Functionally Graded Materials" (MM&FGMs) held in the Taua resort, Atibaia, SP, Brazil, from October 19th to 22nd, 2014. The symposium brought together researchers working at the forefront of applied mechanics, material science and engineering, physics, chemistry, optimization, manufacturing, characterization, experimental and numerical methods to contribute toward a better understanding of materials behavior. For the specific purpose of the present special issue, the papers can be partitioned naturally in three categories, as outline below.

The **first group of papers** involves homogenization (G. Wang & M.-J. Pindera), variational formulations (H. Chi & G.H. Paulino), and atomistics (P.P. Pratapa & P. Suryanarayana). The **second set of papers** encompasses multiscale modeling such as polycrystalline nickel-based superalloys (S. Ghosh, G. Weber & W. Keshavarz) and environmentally sustainable cementitious composites (J. Kang & J.E. Bolander), dispirations (A. Yavari), and stress analysis of functionally graded shells (M.G. Rivera & J.N. Reddy). The **third and final set of papers** covers different aspects of fracture involving assessment of cohesive traction-separation relations (H. Park, H. Choi & G.H. Paulino), fracture of bamboo (S. Askarinejad, P. Kotowski, S. Youssefian & N. Rahbar), fracture characterization of gas shale via scratch testing (A.-T. Akono & P. Kabir), interfacial fracture (H.J. Choi), and thermodynamic consistency of the PPR cohesive constitutive model (D.W. Spring, O. Giraldo-Londoño & G.H. Paulino).

Figure. Aerial view of the Taua resort, Atibaia, SP, Brazil, which was the home of the "13th International Symposium on Multiscale, Multifunctional and Functionally Graded Materials" (MM&FGMs), October 19th–22nd, 2014.

The articles included in this special issue represent a relatively small subset of the field of multiscale, multifunctional and functionally graded materials. It is our hope that the work reported here will be of interest to the community and serve as a source of inspiration for new and continued research efforts in this area.

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http://dx.doi.org/10.1016/j.mechrescom.2016.11.004
0093-6413/