



Editorial overview

Ceramics, composites and intergrowths

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The first two articles in this section focus on ferroelectrics. Hoffman and Kungl address connections between composition, processing, microstructure and large strain behavior of lead-based ferroelectrics. Special emphasis is directed towards the effects of additives in PZT ceramics on defect structure and microstructural development. Recent work and future prospects on high temperature ferroelectrics based on solid solutions of PZT and Bi-containing oxides are also described. The second article, by Landis, focuses on the development of predictive constitutive models for coupled non-linear electromechanical behavior. Such models are essential for assessment of performance and reliability of ferroelectric devices. When implemented in a finite element code, they can be used to ascertain the electromechanical fields in inhomogeneous devices and determine the conditions associated with cracking (typically near electrode tips). Some outstanding challenges are highlighted, including effects of electric fields and remanent polarization on fracture toughness and its anisotropy.

Kahn, Ballerini and Heuer follow with an article that deals with dynamic fatigue of silicon. Discovery of this phenomenon occurred within the past decade, through work on small-scale silicon devices for MEMS applications. Its origin has been at the center of some debate in the most recent past. In an attempt to elucidate the

operative mechanism, the authors combine observations and measurements from various research groups. They conclude that failure likely occurs by mechanically induced damage under cyclic loading. Further discussion on this issue is anticipated.

The section wraps up with a comprehensive review of thermal barrier coatings (TBCs) by Levi. In light of the tremendous progress and attention directed towards this field over the past few years, this article is particularly timely. Indeed, as the author notes, about half of all publications on TBCs in the past 30 years have appeared since the last Current Opinion review on this topic, in 1999. In addition to describing progress in processing of established compositions of zirconia TBCs, the article addresses developments in new materials, including modification of zirconia by rare-earth oxide additions and pyrochlore oxides such as lanthanide zirconates, driven largely by the goal to reduce thermal conductivity. Issues associated with the compatibility of the new compositions with thermally grown oxides and the related effects of coating reliability are highlighted. The merits and challenges of multiplayer concepts are also explored. With the increased collaboration between industry, government laboratories and academia, the activity and progress in this field are expected to flourish in the coming years.

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