Foreword

Quantification of Texture and Microstructure Gradients in Polycrystalline Materials

Microstructural gradients exist in many polycrystalline materials due to fluctuations in local deformation and/or thermal gradients during thermomechanical processing. These gradients include grain size, crystallographic texture, grain boundary structure and phase morphology (including voids), among other features. Structural gradients lead to local differences in material properties that sometimes are preferably avoided (such as grain size and texture variations through the thickness of thick plates or ultrafine grained metals), but that alternatively can be exploited to achieve optimal properties in designed components. Functionally graded materials require the use of structural gradients to vary the properties of a component from one location to the next by means of strategic processes including 3D metal printing and other novel manufacturing procedures. The concept of microstructure sensitive design also often dictates that the microstructure vary from position to position in a material to exploit known structure–property relationships to optimize design of a given part. Statistically reliable quantification of such structures requires strategic measurements by direct three-dimensional observation or by stereological techniques that can retrieve the required information. Mathematical representation of such structures requires a spatially specific description of the requisite structural features.

The symposium entitled “Quantification of Texture and Microstructure Gradients in Polycrystalline Materials,” and sponsored by the Advanced Characterization, Testing and Simulation (ACTS) committee of TMS was held as part of the MS&T 2012 meeting in Pittsburgh, PA. More than 40 lectures were given, including discussions involving advanced experimental techniques, characterization strategies, and new developments in modeling of structural evolution for these materials. A small selection of manuscripts from these presentations is included in this special section of *Metallurgical and Materials Transactions A*.

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