Foreword

Multiscale Perspectives on Plasticity in HCP Metals

Hexagonal close-packed (HCP) metals are technologically relevant as structural materials in a wide range of applications. Of particular importance is the mechanical response of these materials in complex loading environments experienced in automotive, aerospace, nuclear energy and biomedical applications. The mechanical behavior for such metals is complex, because materials with HCP structure have relatively low crystal symmetry (compared with cubic materials), and depend on both twinning and slip for ductility. Twinning, in particular, is an important aspect of plasticity in hexagonal materials, but the underlying mechanisms for twin nucleation, growth, and interaction with dislocations are still not completely understood. For this reason, the thorough understanding, and subsequent modeling, of mechanical behavior in hexagonal systems is often challenging. To address this challenge, a symposium was convened during the TMS 2014 Annual Meeting, held February 16-20, 2014 in San Diego, California, USA. The following manuscripts in the special topic ''Multiscale Perspectives on Plasticity in HCP Metals'' are based on material presented during this meeting.

The symposium focused on the structure–property relationships unique to HCP materials. Special emphasis was given to the necessary interplay between experiments and modeling/simulation to understand the plasticity mechanisms and to develop accurate predictive models. The symposium was a showcase of the many experimental and modeling techniques used to explore plasticity in HCP metals, and further the understanding of mechanical behavior at the many length and time scales relevant to these materials. Major themes of the symposium included:

- Microstructural observations (including dislocations, twins, grain and twin boundaries) used to validate or direct modeling efforts
- Mechanical behavior of HCP materials, especially twinning mechanisms and phase transformations, and their contributions to plasticity
- Multiscale modeling and simulation of plastic deformation in HCP materials, including micromechanical and continuum plasticity laws based on nanoscale mechanisms

The focused collection of papers presented below represents a subset of the many diverse ideas and approaches to different aspects of mechanical behavior in HCP metals discussed during the meeting.

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