Advanced Electron Backscatter Diffraction Applications and Techniques

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Since the first automated electron backscatter diffraction (EBSD) results were attained 22 years ago, EBSD has become a common characterization technique in materials laboratories around the world. This has led to advancements and new understanding in not just crystallography but also in microstructural evolution, phase transformations, defects and dislocations, mechanical behavior, failure, and other materials phenomena.

As a complement to scanning electron microscopy (SEM), EBSD is accessible and available to many researchers with little additional sample preparation. With improvements to both SEM and EBSD, it is now possible to analyze large areas for statistically significant data, and as precision increases, higher resolutions and smaller length scales have become accessible. EBSD analyses are also being combined with other characterization and analysis techniques to provide new insights.

Although EBSD has matured and measurements have become more commonplace, new techniques, applications, and approaches continue to be introduced regularly. This collection of articles focuses on the versatility of EBSD in the range of materials systems presented, as well as on new techniques and applications of EBSD for materials characterization. Examples of the combination of EBSD with other characterization techniques include the supplementation and enhancement of EBSD data by transmission electron microscopy (TEM), atomic force microscopy (AFM), and electron channeling contrast imaging. Novel approaches to strain measurements, and the analysis of stacking faults, defects, and dislocations are also presented. The versatility of EBSD is demonstrated in the range of materials systems represented in these articles; EBSD analyses of conventional polycrystalline metals and alloys, novel lightweight alloys, second

phase precipitates, and the complex structures of thin film solar cells are presented.

The article from D. Abou-Ras and his co-workers provides an overview of the application of EBSD on thin-film solar cells. Of particular interest is the integration of EBSD results with several scanning probe microscopy techniques for correlating properties critical to photovoltaic performance with the crystallographic orientation aspects of the observed microstructures. I. Gutierrez-Urrutia, S. Zaeferrer, and D. Raabe have reviewed a novel application of EBSD for imaging crystal defects, such as dislocations, cells, and stacking faults. EBSD is used to determine the optimal diffraction conditions for electron channeling contrast imaging to elucidate dislocation substructures similar to those observed using conventional TEM diffraction. Z. Chen and C.J. Boehlert combine EBSD with AFM to quantify deformation in an AZ31 magnesium alloy, noting that grain boundary sliding has a significant contribution. In the article by T. Ben Britton and colleagues, elastic strains are measured using high-resolution, cross-correlation-based EBSD, presenting three examples of this exciting technique. Finally, Seiichi Suzuki presents a systematic overview of the transmission EBSD technique, which provides very high spatial resolution in orientation mapping.

This collection of articles represents just a sampling of the new and exciting data being collected using EBSD, while also covering a breadth of work that illustrates both the utility and the potential of this important technique. As advancements continue to be made, we anticipate EBSD to fuel further innovative studies and bring exciting results in crystallography, microstructural evolution, materials processing, and microstructure quantification for years to come.

Alexis C. Lewis and Stuart Wright are the guest editors for the Advanced Characterization, Testing and Simulation Committee of the TMS Structural Materials Division and coordinators of the topic "Advanced EBSD Techniques and Applications" in this issue.