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book reviews

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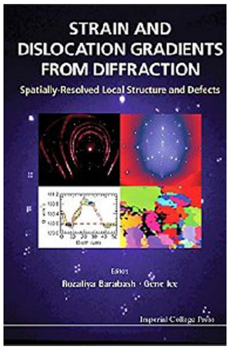

Strain and dislocation gradients from diffraction. Edited by Rozaliya I. Barabash and Gene E. Ice. Imperial College Press, 2014. Price (hardcover) GBP 104. ISBN-978-1-908979-62-9.

In recent years the development of X-ray diffraction (XRD) has opened the door to the possibility of accurately measuring strain gradients in crystalline materials. At variance with other experimental techniques, XRD allows one to investigate structural properties without destroying the samples and to perform *in situ* measurements. In this context, the book *Strain and Dislocation Gradients from Diffraction* highlights how XRD can be exploited to study mesoscale strain gradients and dislocation distributions in deformed crystals.

This book is arranged in 13 chapters; different research groups contribute to each chapter. Chapter 1, written by the two editors of the book, gives a theoretical description of how distributions of defects in a crystal produce strain gradients that can be probed by diffraction. Furthermore, the reader is guided to the conclusion that different dislocation arrangements generate characteristic features in the diffracted pattern.

While the first chapter shows that, from a theoretical point of view, dislocation arrangements can be detected by XRD, the following chapters describe the developments achieved in the past few years in the micro-diffraction techniques to measure the strain gradient and dislocation distribution in crystalline materials.

Complementary micro-diffraction techniques, developed by different research groups around the world, are compared, identifying advantages, capabilities and limitations.

Chapter 2 and chapter 10 are devoted to the description of polychromatic X-ray micro-diffraction (PXM), developed mainly at the Oak Ridge National Laboratory and at the Advanced Photon Source, and to the computer routines used to analyze experimental data. The PXM methodology is useful to study strain and dislocation gradients in polycrystalline materials.

Chapter 3 describes recent developments in the high-energy transmission Laue (HETL) micro-beam diffraction technique. The HETL method is suitable to study material volumes embedded deep in experimental samples.

Chapter 4 illustrates the capabilities of the *XMAS* software, a tool to analyze micro-diffraction data coming from synchrotron facilities.

Chapter 5 presents a technique similar to PXM and developed at the European Synchrotron Radiation Facility (ESRF). In this chapter, the Laue micro-diffraction station of the ESRF is described and perspectives about the planned upgrade are given.

Chapters 6–9 provide an overview of three-dimensional X-ray diffraction microscopy. This approach, useful to study polycrystalline materials, is based on the employment of highly penetrating X-rays and the application of a tomographic algorithm to reconstruct the three-dimensional shape of each grain in the sample.

Chapter 11 shows the capabilities of energy variable X-ray diffraction (EVD). By varying the X-ray energy, the EVD technique allows one to study residual stresses and strains in a given sample with high depth resolution.

Chapter 12 presents a description of the electron backscatter diffraction (EBSD) methods, which are complementary to X-ray micro-diffraction. This chapter highlights that, while EBSD is fundamentally a surface technique, it can achieve a spatial resolution greater than X-ray diffraction methods.

Finally Chapter 13 depicts how X-ray micro-diffraction can be applied to the high-pressure study of materials.

The scientific level of the book is excellent. I recommend this book to scientists interested in understanding the state of the art in characterizing local crystal structures and defects using X-ray micro-diffraction.

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