

X-ray Diffraction for Materials Research: From Fundamentals to Applications. By Myeongkyu Lee. CRC Press, 2016. Hardback, pp. 302. Price GBP 99. ISBN 9781771882989.

Pierre Fertey*

Division Experiences, Synchrotron SOLEIL, BP 48, L'Orme des Merisiers, Saint Aubin, F91192 Gif-sur-Yvette Cedex, France. *Correspondence e-mail: pierre.fertey@synchrotron-soleil.fr

Keywords: book review; X-ray diffraction; materials characterization.

This book is aimed at all those who do not have any background in crystallography and optics and wish to approach the basic notions in crystallography and X-ray diffraction in the simplest way. All the fundamental concepts are presented using only elementary knowledge in mathematics. The text is illustrated by a lot of examples and clear figures. Exercises are also proposed, with solutions for some.

The book is divided into three parts. Part 1 is devoted to generalities on electromagnetic waves and X-rays in particular (Chapter 1), followed by basic notions on geometrical crystallography (Chapter 2) and interference and diffraction (Chapter 3): elements on lattices, crystal systems, directions and planes, reciprocal lattices and elementary crystal structure types are discussed as well as general concepts of refraction, reflection, interference and diffraction. Then, in a second part, the author deals with the theory of X-ray diffraction, starting with the physical origin of the direction of the diffracted beams (Chapter 4): the Bragg law, the Laue equations, the diffraction conditions in reciprocal space, and off Bragg angle diffraction are discussed, and a few words on electron diffraction are given. The intensity calculation is then introduced (Chapter 5) in a classical way, starting from the scattering of an electron to progressively reach the concept of the structure factor and systematic absences. The last part of the textbook is dedicated to some applications of X-ray diffraction. In Chapter 6, the author discusses basic thin-film structural characterizations (out-of-plane and in-plane orientations, stress and strain, and their possible origins) and rapidly introduces grazing-incidence methods and their relevance to (ultra-)thin-film characterizations. Single-crystal orientation determination is the second application of X-ray diffraction described (Chapter 7). The last chapter (Chapter 8) is devoted to powder diffraction. The principle of phase identification is presented followed by a 'manual' determination of the crystal structure of an hypothetical face-centred cubic binary compound possibly having the 'NaCl' or 'ZnS' type structures. This latter paragraph is of a very limited interest with regard to the structure-determination problem. The textbook ends with a single appendix where a simple derivation of the 14 Bravais lattices is presented.

If the basic notions and concepts of crystallography and X-ray diffraction (Parts 1 and 2) are clearly introduced and illustrated by simple examples and clear figures, the last part dedicated to the applications is a bit disappointing: it does not meet the expectations aroused by the enticing title, suggesting a quasi-exhaustive coverage of the characterization techniques using X-ray diffraction in materials science. The applications described in Part 3 are extremely simple and quite restrictive, which may be certainly beneficial for the pedagogical aspects of the book. The lack of bibliographic references, especially in this third part, is rather surprising, bearing in mind the targeted audience (undergraduate and/or early graduate years).

In conclusion, beginners in materials science, physics or chemistry who are interested in understanding the basics in crystallography and X-ray diffraction are definitively the target readers of this book. The aim of the author to introduce crystallography and X-ray diffraction to those completely novice in the field is certainly reached, with a concern for simplicity that will delight those who are frightened



by the rigorous formalism. Even though this book provides a good basis for basic materials characterization using X-ray diffraction, its lack of references to modern tools and more advanced approaches (new X-ray sources, two-

dimensional detectors, experimental methods, data analysis *etc.*) but also the very limited bibliography prevent it from standing out from the long list of similar textbooks in the field.