PREFACE

This book was inspired by the success of a special topical symposium at the annual spring meeting of the German Physical Society in Berlin in 2005 for which the editor was one of the organizers. Such symposia usually attract 10 to 30 papers but this particular one on 'Tomographic Methods in Materials Research' set a new record with 45 papers. This showed that there is a lot of interest in three-dimensional imaging methods both in materials science and in physics. Moreover, it became apparent that a concise treatment of 'advanced' tomographic methods is still lacking.

In contrast to the symposium, this book omits all three-dimensional imaging methods based on destroying the specimen to be investigated, e.g. by cutting, polishing, or milling. There is a reason for this, besides the obvious lack of space: although the information provided by destructive imaging can be similar to that of images obtained non-destructively, the underlying physics and mathematical algorithms differ, and the book would not have had a cohesive theme with all these methods included. With the word 'advanced' in the book title, some of the established methods based on conventional X-ray tubes, nuclear magnetic resonance scanners or other laboratory-based equipment are also excluded. This does not imply that these methods are unsophisticated: rather, the word 'advanced' is used here to reflect the fact that novel third-generation synchrotrons, modern neutron sources, and electron guns in the most sophisticated transmission electron microscopes are also being used to capture three-dimensional images of materials and components. This represents new opportunities for a large community of engineers, materials scientists, or applied physicists, who are the target group of this book in terms of profession. The book should be useful for senior undergraduates and postgraduates, as well as for postdoctoral workers.

Before beginning a description of the individual tomographic methods, some fairly general introductory chapters on the principles and mathematics of tomography, and the basic interactions between matter and the three radiation types considered, are given. Ample reference lists in each chapter allow the reader to seek out information that is not contained in the book. However, the book is conceived such that the concepts of advanced tomography can be understood without necessarily having to read further, more specialized literature.

The field of three-dimensional tomographic imaging is developing quickly, and the more the community of materials researchers gets to know the available methods, the more exciting applications will emerge from their work. One aim of this book is to stimulate such work.

John Banhart, Berlin, June 2007