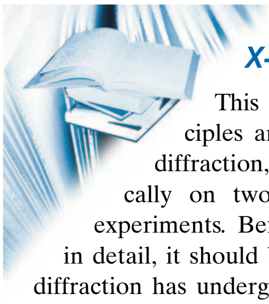


## Two-Dimensional X-Ray Diffraction

This book describes the principles and applications of X-ray diffraction, concentrating specifically on two-dimensional diffraction experiments. Before reviewing the book in detail, it should be mentioned that X-ray diffraction has undergone a fundamental technological change during the last 15 years. With the introduction of area detectors in the 1990s it became possible not only to record diffraction images in two dimensions, but to evaluate these electronic images directly. Within a few years this new technology almost completely replaced point detectors in the field of single-crystal X-ray diffraction, but the situation in powder X-ray diffraction and small-angle scattering is more diverse. Therefore, *Two-Dimensional X-ray Diffraction* focuses predominantly on these latter two subjects.

The author is the director of R&D for a leading manufacturer of X-ray analytical apparatus, and has several decades of experience in developing new diffraction technologies. This experience is reflected in the very detailed description of the fundamental mathematical and physical concepts of this new detector technology and of its application in crystallography.

The book is divided into 13 chapters, which comprise a theoretical crystallographic part (Chapters 1 and 2), a part on instrumentation (Chapters 3 to 5), and finally eight chapters describing a diverse range of applications of two-dimensional X-ray diffraction. The introduction to crystallographic theory is rather brief, and unfortunately not entirely correct. However, the sometimes confusing differences between a primitive trigonal unit cell and the R-centered unit cell with hexagonal or rhombohedral axes have also been mixed up in previous publications. For readers new to the subject, a textbook on crystallography will be indispensable, whereas experts might as well omit this chapter.

The second chapter provides a compilation of the geometrical foundations of X-ray diffraction, with particular emphasis on the specifics of two-dimensional detectors. The many mathematical equations and expressions that are given should enable the user to apply this knowledge in practice. This way of presentation is in my view a big advantage of the book. It would require a substantial effort to compile such a collection from the original literature.

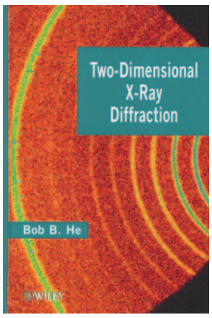
The following chapter contains a brief discussion of X-ray sources (in particular X-ray tubes), followed by a more detailed treatment of X-ray optics. The author explains the design and functions of simple optical elements (Soller slits and pinholes) and of focusing X-ray mirrors. Alternative technologies are compared to each other (Chapter 3). Detectors, which are of central importance for two-dimensional X-ray diffraction, are treated in depth in Chapter 4. A historical introduction leads into a description of the latest technological developments. The reader is given an insight into the technology of the detector, which is generally treated simply as a black box in many crystallographic texts. A chapter on goniometers and sample mounts concludes the part on instrumentation.

Chapter 6 contains a wealth of physical and mathematical information on data reduction. The previous comment about the special merits of Chapter 2 also applies here; there is hardly any other source that compiles and presents the fundamentals of applied two-dimensional diffraction in such detail.

The second half of the book is devoted to applications. Each chapter is structured along the same lines. A short introduction to the topic is followed by the theoretical background, and then the measurement strategy and data reduction procedures are discussed. Each chapter concludes with some typical examples of the method. The methods discussed are those of phase identification, texture analysis, stress and strain effects, small-angle scattering, combinatorial crystallography, and quantitative analysis. Although most of the methods have been treated before in separate monographs (including aspects of two-dimensional data collection and data analysis), there is merit in this part, supplementing the theory and instrumentation of the first half of the book.

The final chapter, the 13th, presents a look into future developments in the field of two-dimensional X-ray diffraction. It remains to be seen which of the developments discussed in this chapter, such as that of scanning linear detectors with very high angular resolution, positioned vertically to the plane of the diffractometer, or that of three-dimensional detectors capable of following the trajectory of an X-ray photon, will actually be realised in the short or medium term.

The book is primarily a superb desk-top reference source for scientists who want a deeper insight into the technology of area detectors, or who need to design new experiments that build on the mathematical and geometrical conditions of two-dimensional X-ray diffraction. Users of “one-dimensional” X-ray diffraction and X-ray scattering will find convincing examples and interesting ideas for the implementation of the new two-dimensional technologies. The detailed lists of references at the end of each chapter (which unfortunately fail to include a couple of pioneering

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works) and the detailed index give rapid access to the primary literature and reviews.

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## Giant Molecules

Improvements in education in recent years can in a large part be attributed to the beauty and readability of modern books. Consider, by way of contrast, how instructional books used to be. As a boy I had to endure the dreadful, pictureless *Hugo's German Simplified*. In text written on newsprint, I read words such as dative, genitive, and accusative along with six ways to say "the" … all this appearing on the first page! Students should cheer that books such as *Giant Molecules* by Walter Gratzer are now available. In a small book, with only about 250 pages, potential drudgery has become joy as the author describes both natural and synthetic polymers. Polymer science, made even more interesting by historical vignettes, includes topics such as: muscle contraction, graphene, dendrimers, DNA computers and machines, polymerase chain reaction, photonics, microarrays, plastic organs, proteoglycans, Nafion, mucopolysaccharides, biometrics, rubbery elasticity, supramolecular polymers, cosmetics, desalination, and adhesives, to name but a few.

An inevitable question arises: To whom is this book intended? The author writes: "The narrative demands no advanced or specialized knowledge and is meant to be accessible to the layman. Chemistry at a basic level would of course be helpful." In my view the goal of the author has only been partially met. Since an enormous amount of subject matter is covered in a short book, its "information density" seems at times rather compressed. The problem is compounded by an absence of diagrams at places where pictorial representations are clearly called for. Consider the following non-illustrated quote, selected more or less arbitrarily, from a section entitled "Photonics":

"In the photoreactive device, stacks of polymer sheets with alternating higher and lower refractive index stripes can produce, by virtue of constructive interference (intensity reinforcement wherever two light rays oscillate in phase—the peaks of the waves exactly coinciding), a very high reflectivity for light of a chosen wavelength, determined only by the thickness of the layers. The refractive index is controlled by 'doping'—in short contaminating—the polymer sheets with a suitable material. This is commonly a collection of tiny beads, a few ten thousandths of a centimeter across; they are generally made of silica (quartz), but block polymers have also been synthesized in which the blocks spontaneously fold on themselves to form submicroscopic crystal-like cubes, to produce a similar effect. With such devices holographic images can be repeatedly created, expunged, and replaced. Other geometrical forms should inspire new developments."

It is difficult for me to imagine a layman grasping this paragraph. More likely, eyes will glaze over. But this is not quite fair. The book does have lucid and entertaining material in it. For example, consider this gem:

"A remarkable example of a composite, ill-starred as it proved, was pykrete, developed during World War II by the eccentric inventor Geoffry Pyke. The plan was to construct floating airstrips in the North Atlantic on which aircraft flying between America and Britain with war materials could refuel. Ice is highly brittle—a block of ice struck with a hammer will shatter—but Pyke found that if packed with wood-pulp fibers it was transformed into a medium, pykrete, of enormous toughness. When Pyke demonstrated the properties of his invention before a group of dignitaries by firing a revolver at the block of material, the bullet ricocheted around the room, narrowly missing several spectators."

I will include this story during a lecture on polymers and composites in my science and technology course (given annually to a class of 80 humanists). I learned of it, along with many other accounts, from *Giant Molecules* by Walter Gratzer.

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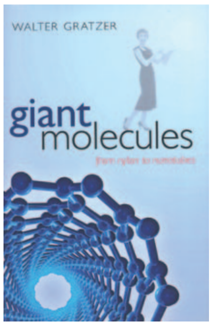


**Giant Molecules**
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