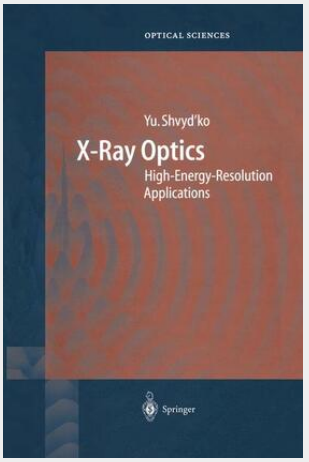
Shvyd'ko

X-Ray Optics

High-Energy-Resolution Applications



The use of x rays has moved in the forefront of science and technology in the second half of the 20th century. This progress has been greatly stimulated by the advent of synchrotron x-ray sources in the 1960s. The undulator-based synchrotron radiation sources which have appeared in the last decade of the 20th century gave a new impetus to such development. The brilliance of the x-ray sources has increased by 12 orders of magnitude in 40 years and this trend does not show any signs of stagnation. The future x-ray sources of the 21th century based on free-electron lasers driven by linear accelerators will provide sub-picosecond radiation pulses with by many orders of magnitude higher brilliance and full transverse coherence. The x-ray sources of the newest generation offer a possibility to realize more than ever before the great potential of x-ray optics and, as a consequence, to elaborate new sophisticated instrumentation with unprecedented resolution and eventually to move in new directions of research in x-ray technology, materials science, fundamental physics, life sciences, etc.

The generation of radiation with well-defined frequency and wavelength, and the ability to precisely determine these quantities, are of fundamental importance in physics and other natural sciences. Monochromatic radiation enables both very accurate structure determinations and studies of the dynamics of living and non-living matter. It is crucial for the realization of standards of time and length, for the determination of fundamental constants, and for many other aspects of basic research. Bragg backscattering from perfect crystals is a tool for creating, manipulating, and analyzing x-rays with highest spectral purity. It has the unique feature of selecting x-rays with narrow spectral bandwidth. This book describes the theoretical foundations and principles of x-ray crystal optics with high spectral resolution. Various experimental studies and applications are presented and the author also addresses the development of instrumentation, such as high-resolution x-ray monochromators, analyzers, wavelength meters, resonators, and interferometers. The book will be a valuable source of information for all students and researchers working in the field of x-ray optics.

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