

Preface

The main purposes of this book are to summarize the recent developments and advances in femtosecond beam science and to make them accessible to researchers, engineers, technicians, graduate students and postdoctoral researchers. Femtosecond beam science is a development of femtosecond laser spectroscopy and pump-and-probe analysis, for which Prof. A. H. Zewail won the Nobel Prize in Chemistry in 1999. Femtosecond beam generation comprises visible lasers, electrons, X-rays, ions, THz radiation, positrons, neutrons and so on. This science is expected to lead to the development of technology to realize dynamic microscopy, that is, the visualization of atomic motions, chemical reactions, protein dynamics and other microscopic dynamics. Advances have already realized the visualization of atomic motions and enabled the visualization of phonons thermal expansion and shock wave propagation by advanced time-resolved X-ray diffraction, at a time resolution of 10 ps. These achievements will act as a bridge to the development of femtosecond X-ray sources and fourth generation synchrotron light sources. Dynamic microscopy promises to be one of the most important issues in dynamic nanotechnology in the near future. For this reason, we felt it was necessary to provide an overview of femtosecond beam science to assist current and future researchers in the field, and hopefully to accelerate the progress of the field.

In this work, the theories, state-of-the-art techniques and recent achievements in femtosecond beam science are described by worldwide leaders in the field. In early 2002 I was asked by Imperial College Press/World Scientific to publish a monograph on this topic. I proposed the title of “Femtosecond Beam Science” and sent in a proposal with preliminary contents. After it was reviewed and approved in August 2003, I decided to ask prominent pioneers, who are at the forefront of this fascinating science,

to cooperate in producing this volume and make it of much higher quality than I could manage alone. They responded perfectly with excellent contributions within only a few months. I deeply appreciate their understanding, effort and hard work. I expect this book will be useful especially for young researchers and graduate students. To make it easy to understand for these readers, I asked all co-authors to keep to the following style.

- Start by explaining their particular subject as simply as possible, for example by using a schematic drawing that shows how it works.
- Briefly review recent advances worldwide.
- Feature at least one of their more important results.
- Even if femtosecond pulses are not yet used in their particular area, foresee future uses of femtosecond pulses.

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