

Preface

The chromosome was discovered in the 19th century and even now its structure has not been elucidated, making it one of the main research target materials in the next era of the life sciences. The chromosome has a complex and still largely undefined structure that appears during cell division and that consists of two DNA molecules, histone proteins and nonhistone proteins. Techniques in molecular biology have yielded detailed information on the structure and function of the chromosome; e.g., *in situ* hybridization of fluorescently labeled DNA probes to the complementary DNA in chromosomes enabled the visualization of genes in specific regions of chromosomes. The sequence information of chromosomes of humans and some plants and animals has now been decoded, and has been utilized in numerous biological fields from basic biology to medicine.

Novel analyses beyond the DNA level are, however, now awaited for the further advancement of chromosome science and technology. Recent advances in nanoscience and nanotechnology are casting new light in every biological field. Thus, we developed a national project on nanobiology in the field of chromosome science in the year 2000, supported by the Japanese government as acknowledged at the end of each chapter. Six years cover the academic trend—from when the term “nanobiology” sounded a little bit strange, until the term became fashionable. Without the generous government support for opening of this new biological field, our goals could never have been attained, because the project itself is very multi-disciplinary and the members are a collection of researchers from the disparate backgrounds of molecular biology, biochemistry, protein science, immunology, genetics, cytogenetics, microbiology, anatomy, pharmaceutical science, semiconductor production, polymer chemistry, electronic chemistry, material science, microscopy, biometry, bioinformatics, medical informatics and others.

This book reviews the newest trends in this biological field to which nanoscience and nanotechnology have been very successfully applied and have played various important roles. This book is also the report of our 6-year Japanese national project. The book consists of four main parts with 18 chapters: (1) devices for chromosome handling, (2) visualization of chromosomes at nano- and micro-levels, (3) chromosomes as nanomaterials and (4) informatics of chromosome images. In Part I, construction and successful application of various nano- and microdevices, such as a device for microdissection of chromosomes, a microchip for on-chip chromosome sorting and a micromanipulator for measurement of the dynamic properties of chromosomes are introduced and reviewed, based on the results of successful application of these techniques. In Part II, the most advanced methods for allowing simultaneous observation of topological and fluorescent images after FISH at the nanolevel, and for revealing nanolevel folding of chromatin fibers by atomic force microscopy even in a solution, for example,