Preface

Multimodality molecular imaging is a combination of imaging strategies that are playing an increasing role in all biological, biomedical, and clinical fields. Molecular imaging can be used to study a whole variety of molecular events in cells, tissues, organs, and the whole body of living organisms. This includes detecting and measuring the levels of mRNA, proteins, enzymes, and protein-protein interactions. Additionally, molecular imaging can be used to detect intracellular metabolic events, the presence and quantity of specific cells within tissues, and changes in cell characteristics through time. Adding to the power of molecular imaging is the fact that many of these techniques can be applied non-invasively in living subjects, allowing repetitive interrogation of molecular events within intact systems.

Reporter genes are among the most powerful tools in molecular imaging. They were originally introduced several decades ago for studying biochemical events *in vitro* including cell/tissue lysates. Later, their use advanced to optical imaging of molecular events within intact cultured cells using microscopes. It was in the early 1990s that imaging reporter genes of several types were developed for non-invasive molecular imaging in *living* subjects. Imaging reporter genes are general tools for imaging gene expression, protein function, protein-protein interactions, and a variety of other molecular events, repetitively and usually non-invasively within living organisms, including humans. Besides their applications in biological research, they have many biomedical applications, including disease diagnosis and optimization of therapeutics.

This is the first book dedicated to teaching all aspects of multimodality molecular imaging of reporter genes. Imaging reporter genes are now available for optical, magnetic resonance, and radionuclide-based imaging systems. We have gathered international experts in the field to detail reporter gene systems of all imaging modalities (Chapters 1–4). In Chapters 5–6, leading scientists describe available techniques for enhancing the power of imaging reporter genes through multimodality imaging and gene expression amplification strategies. There is also a dedicated chapter on instrumentation for reporter gene imaging in animal models and humans (Chapter 7). Chapters 8–12 were written by molecular imaging experts who have worked extensively to develop many of the current applications of imaging reporter genes. Finally, the book concludes with Chapter 13, which discusses the current progress using imaging reporter genes in cell and gene therapy clinical trials.

This book should help investigators in all biomedical fields to learn about imaging techniques based on reporter genes that are essential for the study of molecular events within intact living systems. We also hope that this knowledge will lead to the development of new applications for imaging reporter genes. Graduate and medical students in all biological and medical fields will also benefit from learning about the technologies described in this book. Investigators in biotechnology and pharmaceutical firms will be able to use the technologies described in this book in their search to optimize novel therapeutics. Finally, clinical investigators, especially in regenerative medicine, cell therapy, and gene therapy will gain tremendous benefits from the knowledge of imaging reporter genes and their applications in clinical therapeutics.