Preface

The seed for this book came from a review article published three years ago [1]. At the time a reviewer suggested that a book on polarizabilities was needed. Since the polarizability is a physical property of particles and materials that is so pervasive and important in describing and understanding the interaction of particles and electric fields, the need for such a book was clear. In this book we have aimed to clearly describe the polarizability as an electronic property, to discuss its importance in the physics and chemistry of atoms, molecules, and clusters, and to review theoretical and experimental techniques for deducing its value in a wide range of particle classes. A rigorous review of the frequency dependence and tensor properties of the polarizability is given. In addition, the last chapter attempts to provide some examples of the relation of the polarizability to important phenomena under recent study such as atom cooling and trapping, optical tweezers, and long-range interactions.

The ubiquitous occurrence of polarizabilities in physical phenomena has spawned a large literature that spans many fields: physics, chemistry, engineering, and biology. It is difficult to manage and maintain a complete command of this vast body of literature. However, we hope that one of the lasting effects of this book is to give an adequate summary of relevant work up to 1996 in the areas covered. We apologize in advance for not citing works that are relevant but that we missed. Also, as with any book, there are invariably mistakes that we inadvertently missed or that were made due to a lack of understanding on our part. In both of these cases, we ask our readers to provide us with a gentle reminder of our errors in exchange for the promise that we will try very hard to avoid the same mistakes in the future.

Many friends and colleagues have helped us in this endeavor, and we gratefully acknowledge their contributions. In particular, KDB thanks Will Happer for encouragement and moral support and especially for introducing him to this important subject in the first place. He is ever grateful to A.R. Marlow for long-term friendship and intellectual support. VVK learned about clusters, polarizabilities, and good science in general from Walter Knight, whose kind support and friendship are deeply appreciated. Joe Louderback was kind enough to read the entire manuscript twice and we thank him for his helpful feedback. We thank Thad Walker for many discussions on all aspects of atomic polarizabilities. We are also grateful to many others for their valuable comments on individual sections or whole chapters, viz., Jörg Becker (semiconductor clusters), Walt de Heer (position-sensitive time-of-flight polarizability technique), George Holzwarth (optical tweezers), Uwe Hohm and Dirk Goebel (refractive index measurements and dispersive Fourier-transform spectroscopy), Mark Pederson

(theory chapter), Dave Pritchard (atom interferometry), Dany Shapiro (biomolecules and organic molecules), and Thad Walker (atom cooling and trapping). Others who gave important comments on the review article that were incorporated into the book include D. Bishop, A.D. Buckingham, and Tom Miller. We owe a debt of gratitude to Michael Kadar-Kallen for his contributions to the experimental techniques chapter (from the original article). His sections formed the core for roughly half of Chapter 5. Judy Swicegood is to be thanked for her help on the bibliography. Many colleagues graciously permitted us to reproduce figures from their papers and provided us with original copies. Work on this book was partially supported by the U.S. National Science Foundation Programs in Chemistry and Atomic, Molecular, Optical, and Plasma Physics (KDB) and Atomic, Molecular, Optical, and Plasma Physics (VVK). KDB thanks Wake Forest University for providing excellent computer facilities and personnel (in particular C.W. Yip).

Finally, a special appreciation goes to our families. KDB thanks his children, Alex, Claire, and Caroline, and his wife, Marian, for cheerfully accepting a father and husband whose frequent physical absences, blank looks, and empty stares all indicated a mind present elsewhere. VVK is infinitely grateful to his wife, Susan, for her patience and support.