This volume provides a comprehensive overview of the use of ultraviolet laser radiation in the processing of materials. It is the first book to cover all the major up-to-date applications of UV lasers in a unified approach.

The development of lasers operating at ultraviolet wavelengths has provided materials scientists and engineers with a new set of tools. These combine the ability to vaporize the most refractory of materials with the precision to ablate micrometer-sized holes in polymers and the ability to remove thin layers from the cornea for correction of refractive errors in the human eye. This book outlines these applications and explores the use of UV laser radiation for the ablation and deposition of metals, insulating solids, polymers, semiconductors and superconductors. Emphasis has been placed on understanding the physical mechanisms accompanying these processes and the conversion of intense UV radiation to photothermal and photochemical energy in irradiated materials. An extensive bibliography has been included.

UV Lasers: effects and applications in materials science will be an invaluable source of current information in the rapidly developing field of laser applications for engineers, scientists, researchers and students in universities, government laboratories and the private sector. This book will also be valuable as a supplementary text for graduate courses in materials science.

UV Lasers: effects and applications in materials science

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Preface

The development of lasers operating at ultraviolet wavelengths has provided mankind with a new set of unique tools. With characteristics which combine the precision to remove micrometer-thick layers of corneal tissue for the correction of refractive errors in the human eye and the ability to vaporize even the most refractory of materials, UV lasers have immediately developed into indispensable tools in many areas of materials science. The remarkable ability of high power pulsed excimer laser radiation to vaporize complex materials such as high temperature superconductors, while maintaining stoichiometry in thin films deposited from this vaporized material, offers many exciting opportunities in the creation of superconducting thin films and thin film devices. Similar unique capabilities are available in the deposition, doping and modification of semiconductors using UV laser radiation.

As a result of these and other applications, many of which can be immediately adopted by industry, UV lasers have a secure future in the field of materials science. Their implementation is limited only by our creativity in finding new applications and ways to use these new tools.

A fascinating aspect of the development of these applications involves the many fundamental questions that arise concerning the manner in which intense UV laser radiation interacts with matter. This is an area of great scientific interest and is truly interdisciplinary in nature so that answers to these questions will only come from both theoretical and experimental studies extending over a diverse range of disciplines.

In writing this book I have adopted the thesis that new applications, together with the refinement of present applications, of UV lasers will come only as we gain a deeper understanding of the mechanisms involved in the interaction of intense UV laser radiation with matter. My approach has therefore been to focus on these mechanisms and their relation to applications of UV laser radiation in materials science. Since interaction mechanisms tend to be most closely related in materials with similar properties, my discussion is then organized in this way with chapters on UV laser processing of metals, insulators, semiconductors and superconductors. The important field of laser deposition is discussed in a separate chapter. Sources of UV laser radiation together with ancillary components and systems are discussed in the first chapter. Chapter 2 provides a summary of the properties of materials at UV wavelengths, whereas Chapter 3 discusses the limitations of laser processing in a more general way. A comprehensive, but by no means exhaustive, bibliography is also provided to assist the reader in gaining access to the burgeoning literature on this subject.

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