

Preface

The classical phenomenon of light scattering is one of the most studied topics in light-matter interaction and, even today, involves some controversial issues. A present focus of interest for many researchers is the possibility of obtaining information about microstructures, for example surface roughness, and the size, shape and optical properties of particles by means of a non-invasive technique such as the illumination of these objects with light. One of their main tasks is to extract the relevant information from a detailed study of the scattered radiation. This includes: measurement of the light intensity in different directions, analysis of its polarization, determination of its statistics, etc. Contributions to resolving this problem are important not only from the point of view of increasing basic knowledge but also in their applications to several fields of industry and technology. Consider, for example, the possibility of distinguishing between different types of atmospheric contaminants, biological contaminants in our blood, the detection of microdefects in the manufacturing of semiconductors, magnetic discs and optical components, or the development of biological sensors.

During the period September 11-13, 1998, we brought together a group of international experts on light scattering at the Summer School of Laredo at the University of Cantabria. In a series of one-hour lectures, they discussed current aspects of light scattering from microstructures with special emphasis on recent applications.

The present book condenses those lectures into five parts. After a general introduction to light scattering from microstructures, three important topics are reviewed in the theoretical section (Part I): the basic electromagnetic theory for dealing with microstructures on substrates, the mathematical methods for data inversion, and an original presentation of the Mueller matrix as a tool for analyzing light scattering experiments.

Part II reviews some of the most relevant numerical methods used for solving the scattering problem for particles on substrates. It addresses basic geometries for the particles (sphere and cylinder) and finishes with the more general problem of irregular structures.

The polarization of scattered radiation by microstructures is also reviewed (Part III) in two contributions. These describe, among other things, the multiple scattering and depolarization effects caused, respectively, by very small particles and by those of the order of, or larger than, the incident wavelength.

The analysis of the statistics of scattered radiation can give insight into solving the “inverse problem” (Part IV). Two chapters are dedicated to presenting some background on this interesting topic. They show how information can be obtained about scattering particles when they are isolated or, alternatively, located on substrates.

Finally, the last and most extensive part of the book, Part V, contains some of the most relevant applications of scattering from microstructures in both basic and applied research. These include, among others, Surface Enhanced Raman Scattering (SERS), monitoring and detection of surface contamination by small particles, optical communications, and new particle sizing techniques.

An essential feature of this book is that it has been organized in a tutorial way, so that both researchers and students (mainly postgraduates) can familiarize themselves with these problems. To guarantee the objectivity and the scientific quality of this book, all of the contributions have been written by internationally renowned researchers in the field of light scattering. We want to express our gratitude to all of them for their excellent work. Of course, all of these efforts would have been in vain without the collaboration of many individuals, and public and private organizations. Hence we wish to thank: both the academic and administrative staff of the organization team of the Summer School of Laredo at the University of Cantabria, the Ministry of Education and Culture of Spain for its economic support under grant No. C097-0146 and the research project PB97-0345. Other public support came from the Consejería de Educación y Juventud (Gobierno de Cantabria) and the University of Cantabria through the Vice-rector of Research, the Faculty of Sciences and the Department of Applied Physics. Our gratitude goes out to all of them. We are also grateful for private financial support from Hewlett-Packard, Lasing S.A. and Optilas S.A. Finally, many, many thanks to our colleagues Gordon Videen, Pedro Valle, José María Saiz and José Luis de la Peña for their invaluable help in reviewing the contributions and editing the manuscript.

Santander,
September 1999

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Light Scattering from Microstructures

Lectures of the Summer School of Laredo, University of
Cantabria, Held at Laredo, Spain, Sept.11-13, 1998

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2000, XII, 300 p. 121 illus., Hardcover

ISBN: 978-3-540-66937-1