

Topics in Applied Physics Volume 50



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Light Scattering in Solids II

Basic Concepts and Instrumentation

Edited by M. Cardona and G. Güntherodt

With Contributions by

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With 88 Figures

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This book is dedicated to the memory of
S. P. S. PORTO
who contributed so much to the field of
Light Scattering in Solids



Preface

This book is the second of a series of four volumes devoted to the scattering of light by solids; the first one appeared as Vol. 8 of *Topics in Applied Physics* in 1975. Since then so much progress has occurred that the editors have found it necessary to put together three new volumes in order to give a glimpse of the field. The volumes cover inelastic scattering, in its spontaneous and stimulated forms, by phonons, magnons, and electronic excitations in crystalline and amorphous solids. Molecular phenomena are sometimes included when they help to clarify or to contrast typical solid-state phenomena and for reference purposes in light scattering from adsorbates at surfaces. Several important topics, such as the rapidly developing field of light scattering by polymers, have been left out completely. The material covered ranges from instrumentation to theory touching also problems of specific materials.

The range of information obtained with light scattering is very wide and pertains to many branches of the natural sciences, from biophysics to chemical engineering and ecology. While these books address mostly the interests of the solid-state physicists, a number of chapters, such as those concerned with instrumentation or with the general theory of light scattering, will find widespread interest among all practitioners of Raman and Brillouin spectroscopy. Most articles should also be of interest to light scattering specialists in other fields interested in looking beyond the narrow range of their immediate concerns.

The present volume is devoted to the general principles and the main experimental techniques, both linear and nonlinear, of light scattering. The Introduction describes the scope of this and the other volumes of the series. The second chapter provides an extensive discussion of the theory of light scattering with particular emphasis on resonant phenomena. An effort is made to unify the various ideas involved around the concept of differential susceptibilities. Simple rules are given to calculate scattering cross sections or efficiencies and the results are compared with experimental data. Chapter 3 discusses one of the most important recent developments in the field of instrumentation for light scattering spectroscopy, namely multichannel detectors. At the moment it is fair to say that this development, is "state of the art". Considerable amount of effort is still required in order to make these systems commercially available. It is our believe that they are the way of the future. The spectroscopist will find in this chapter valuable hints for design and purchase. The final chapter reviews nonlinear light scattering spectroscopy with special emphasis on hyper-Raman

techniques and coherent antistokes Raman scattering (CARS). These methods are, at present, the object of very intensive research effort.

The editors would like to express their deep appreciation to a large number of scientists, graduate students and colleagues at the Max Planck Institute in Stuttgart, at Brown University, Rhode Island, at the IBM T.J. Watson Research Center, Yorktown Heights, and at various other institutions for their collaboration, help and contributions. The names of all those who helped to “push the frontiers” of the field of light scattering will be found throughout the references of the various chapters, releasing the editors from the cumbersome burden of mentioning them all here. It is a particular pleasure to thank all of the contributors for keeping their deadlines despite other commitments and for their cooperation in considering the editors’ suggestions.

Especial recognition is due to the manufactureres and suppliers of equipment for Raman and Brillouin spectroscopy, in particular monochromators, interferometers, detectors, lasers, and dyes. They have helped to free the scientist from the burden of instrumentation. Without them the progress this book is about to document would not have been possible.

Finally, we would like to dedicate this book to the memory of S. P. S. Porto who so much contributed to the field of Raman spectroscopy.

Stuttgart and Köln,
December 1981

Manuel Cardona
Gernot Güntherodt

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