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Book reviews

Optoelektronik in der Technik
Optoelectronics in Engineering

Proceedings of the 5-th International Congress *Laser 1981*

Edited by WILHELM WAIDELICH

Springer-Verlag, Berlin, Heidelberg, New York 1982
[pp. i–xxii + 580, with 504 Figs. (partly in English and partly in German)]

This book contains the whole texts of 96 original and review papers presented at the 5-th International Congress *Laser 81* held in May, 1981 in Munich, FGR. These papers deal with a broad range of subjects on optoelectronics in engineering, including laser systems (7 papers), laser spectroscopy and laser chemistry (1 paper), laser measurement and testing (27 papers), lasers in material processing (11 papers), lasers in environmental measuring techniques (6 papers), lasers and optoelectronics in space techniques (7 papers), optoelectronic components (12 papers), optoelectronic signal transmission (7 papers), optoelectronic image pickup (6 papers), optoelectronic image and data recording (3 papers), optoelectronic image processing (4 papers), and optoelectronic solar technique (5 papers).

The development and application of lasers and optoelectronics are expanding so rapidly that it is no longer possible for a single expert to be familiar with the entire field. Consequently, since 1973 the Münchener Messe- und Ausstellungs GmbH has organized biennial conferences on this subject, which bring together the specialists from all over the world.

Like its predecessors *Laser 81 Optoelectronics* presented the state-of-the-art, latest results and modern trends in the field. The attendance of well recognized experts ensured a satisfying standard of the contributions.

In general, the papers presented at the Conference (printed in the book) can be divided into three groups.

The first group, unfortunately not too numerous, contains the papers describing original ideas, phenomena or measuring techniques. As an example the paper by ZWINGEL and STEINBICHLER from Diehl GmbH (FRG) can be mentioned. It concerns triple-pulse holography applied to the analysis of aperiodic vibrational modes (especially to impact analysis) in rather hostile environmental conditions. To the same group belong the papers by GAPONTSEV et al. from the Institute of Radioengineering and Electronics in Moscow (USSR) concerning the erbium glass lasers, which operating at $\lambda_{em} = 1.536$ μm can demonstrate a satisfactory efficiency and have a number of advantages compared to the Nd-glass lasers, and by BASOV et al. from P. N. Lebebedev Physical Institute in Moscow (USSR) concerning the longitudinally electron-beam-pumped semiconductor lasers, which exhibit excellent properties in optical memory systems, scanning optical microscopes and colour projection television.

The second group of papers constituting the largest part of this book, consists of contributions in which some perfections introduced to well known measuring equipment or measuring methods are described. The paper by FAGAN from Elomag AG (FRG) can be cited here as an example. This paper deals with a motion compensated, image derotated holographic interferometer (IDHI) and describes a new solution of the well known measuring system. The described interferometer is less critical to set up than the previous systems and compensates for some of the rigid body effects, making the IDHI technique more amenable to industrial environments.

Time-resolved spectroscopy in the picosecond time domain enables the indirect observation of a great amount of the elemental processes in atoms, molecules and solid state bodies. The modified laser systems constructed at Friedrich-Schiller-University in Jena (GDR), for kind of measurements have been described in detail in the contribution of NEUMANN et al. from this University. This contribution also belongs to the second group of papers.

Optical methods for contactless testing are now widely used in the practice. Numerous applications, such as contactless distance, velocity, shape deformation, displacement, and vibration analysis used the laser as a light source. Furthermore, different acousto-optical and electro-optical modulation, and beam deflection devices were also introduced in these measurement techniques. Methods, as well as recording, materials for nondestructive optical measurements were discussed in many papers of the book. Especially interesting is, however, the paper of TIZIANI from the Institute of Technical Optics, Stuttgart University (FRG) giving a very comprehensive review of the whole area of real-time measurements in optical metrology. This paper can serve as an example of the contributions belonging to the third group of papers, to the group of reviews.

Another review paper by KRESSEL from RCA Laboratories in Princeton (USA) concerns the recent advances in optoelectronic semiconductor devices. This paper enables to state the following conclusions:

– Semiconductor laser diodes of AlGaAs and InGaAsP can be produced to address major applications in optical communication and data encoding and readout. Lasers operating in the 0.78–0.85 μm and 1.3–1.6 μm spectral regions have been developed: The earlier gain-guided stripe contact lasers, which provide inadequate mode control, have been supplemented with more sphisticated structures designed for fundamental lateral mode operation at power levels in excess of 10 mW. Values as high as 60 mW have been obtained. Such devices have linear power versus current curves and are thus free of troublesome kinks that impaired the performance of early c.w. laser diodes.

– The progress in the laser technology has been greatly assisted by the improved technical modelling of the waveguide properties of laser diodes. The factors that impact the index of refraction profile and mode stability in complex structures are sufficiently well understood to permit the construction of sophisticated structures having the desired properties.

– The reliability of laser diodes has kept pace with the increased technological improvements. Laser half-life values of 3000–4000 hrs are obtained with AlGaAs lasers ($\lambda_{op} \approx 0.38$ μm) at 70°C. The room temperature data indicate that values in excess of 100 000 hrs should be possible. However, lasers emitting radiation of wavelength below 0.78 μm are prone to relatively rapid degradation. Available data for InGaAsP lasers are encouraging, although extended long term aging data are not yet available.

The book *Optoelectronics in Engineering* contains a wealts of information and ideas that cannot be all mentioned here, because of the volume shortage of this critical review. There is no doubt that this book should thus stimulate research, development, and applications in all areas of optoelectronics. The specific rather than general nature of most of the papers renders, however, the book unsuitable for use as a basic text. Nevertheless, it is a collection of interesting papers which can be referred to individually rather than read as a whole. It brings together quite a number of diverse problems, so as to be of interest to people wishing to get a general feeling of what goes on in the field of laser optoelectronics.

Optoelectronics in Engineering will make a useful addition to the optoelectronics, or laser section of a technical library because of the high quality of its papers and the international renown of majority of its contributors.

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Light Scattering in Solids II, III

Basic Concepts and Instrumentation (II)
Recent Results (III)

Editors: M. CARDONA and G. GÜNTHERODT

Topics in Applied Physics Vol. 50 and 51

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[pp. i–xii + 251, with 88 Figs. (II), i–x + 281, with 128 Figs. (III)]

The referred volumes are continuation of Volume 8 of the denoted series, edited by M. Cardona in 1975. It is, however, the continuation in a limited range because at least three parts would be necessary to report the stormy development of the topic stimulated mainly by the progress in the field of tunable dye lasers. The comparison of the figures describing power spectra for various dyes as a function of the dye laser wavelength obtained in 1975 with those given in the part II is very impressive. On the other hand, difficulties in X-rays and vacuum ultraviolet region are still observed.

The part II contains the following contributions:

— *Introduction*, by M. CARDONA and G. GÜNTHERODT,
— *Resonance phenomena* by M. CARDONA,
— *Optical multichannel detection*, by R. K. CHANG and M. B. LONG,
— *Coherent and hyper-Raman techniques*, by H. VOGT.

In the *Introduction* a brief insight is given into the topic of the whole volume and the content of the 1975 volume, as well as the following and forthcoming volumes. Chapter 1.5 of the *Introduction*, devoted to recent topics and highlights of light scattering in solids, is especially interesting to physicists or even to non physicists wanting to obtain the general information about pure and applied aspects of light scattering in solids which had a significant impact on the field during the past five years. The authors do not attempt a complete survey, but rather want to stress the versality of the methods and various investigated phenomena. The questions of instrumentation and techniques, semiconductors, their surfaces and superlattices, amorphous semiconductors and laser annealing, as well as Brillouin scattering from opaque materials, layer materials, superconductors, spin dependent effects and surface enhanced Raman scattering are reviewed. Note that in 1975 a few of the former questions were an object of experimental investigations.

The contribution by M. CARDONA introduces the concept of liquid scattering on the classical (non-quantum) picture, in the language of the phenomenological polarizability theory. This is done in order to make experimental physicists more intuitive. On the other hand, the introduction of the quantum-mechanical picture becomes necessary to obtain the scattering efficiency in absolute units, which is now experimentally detectable. The whole contribution serves as a theoretical background and nomenclature used in the whole edition. An effort is made to keep the treatment simple, self-contained and understandeable for an average experimental physicist.

The general formulae of quantum theory of light scattering are applied in order to obtain the resonance profiles at critical points in solids. The cases of tetrahedral semiconductors are given as an illustration. The tast Section of this contribution contains experimenial results of resonant scattering phenomena in tetrahedral semiconductors, the yellow excitonic series of Cu_2O and the indirect gap of AgBr.

The contribution by R. K. CHANG and M. B. LONG is devoted to a novel technique in light scattering. The suitable instrumentation is still the object of art; though important, efforts are undertaken to make it the object of commerce. Most important is its application to time- and spatially-resolved measurements, particularly in the applied area. The purpose of this contribution is to help the potential user in choice of the paper experimental system. This is done by making manufacturers' "jargon" transparent and understandable.

The contribution by H. VOGT describes the application of nolinear optical effects in light scattering in solids. The hyper-Raman effect (spontaneous, resonant, stimulated or coherent), the coherent antistokes Raman scattering (CaRS), the Raman-induced Kerr effect and multiwave mixing are objects of this contribution. It presents a unique approach to the problem via nonlinear susceptibilities. Note that the considered phenomena are midway between basic problems of condensed phase and nontrivial technical problems.

Part III is devoted to the recent results in the field of light scattering in solids, distributed according to the type of scatterers. The extremely short introduction by M. CARDONA and G. GÜNTHERODT briefly presents the character of the particular contributions of which the following are quoted below:

— M. S. DRESSELHAUS and G. DRESSELHAUS: *Light scattering in graphite intercalation compounds,*

— D. J. LOCKWOOD: *Light scattering from electronic and magnetic excitations in transition-metal halides,*

— W. HAYES: *Light scattering by superionic conductors,*

— M. V. KLEIN: *Raman studies of phonon anomalies in transition-metal compounds,*

— J. R. SANDERCOCK: *Trends in Brillouin scattering: Studies of opaque materials, supported films and central modes,*

— C. WEISBUCH and G. R. ULBRICH: *Resonant light scattering mediated by excitonic polaritons in semiconductors.*

The first contribution reports the main mechanisms of light scattering by various substances, formed on pyrolytic graphite by more than one hundred of intercalants, used in different concentrations. The Raman scattering provides the key to understand the formation of intercalants superstructures, due to staging, and to measure the phonon spectra of a base graphite, the layers of intercalants as well as the modification of these spectra by the intercalant-graphite interaction.

The icontribution by D. J. LOCKWOOD describes the application of Raman scattering in transit on metal, application of Raman scattering in transition metal halides (cubic threefluorides, tetragonal twofluorides, trigonal layered bromides, chlorides and iodides, in pure and mixed antiferromagnes) to studies of electronic, magnetic and electron-phonon coupled excitations.

W. HAYES deals with the features of Raman scattering in materials with such a substantial disorder that the wave-vector selection rule is usually broken. Hence, the scattering with local ions oscillations and diffusive ions mode are the subject of investigations. Among the studied substances there are alkaline earth halides, silver and cuprous halides, β-alumina compounds as well as some other crystals as grown in the suitable temperature range below the melting temperature.

The reader can substantially deepen his theoretical background by M. V. KLEIN'S contribution since the author gives a detailed though concise introduction into the many-body approach to light scattering, necessary for applications to metals. This contribution being complementary to that by M. CARDONA in part II is devoted to Raman scattering by phonon anomalies in transition metal compounds (mainly A15, carbides, nitrides and dichalcogenides). Except for scattering by electrons or phonons, also scattering by coupled electron-phonon excitations are included. The connection between strong electron-phonon processes responsible for phonon anomalies or phase transitions and strong Raman process is discussed. The important part of the contribution is devetod to Raman scattering from weak and strong charge density wave phonons, also in superconducting systems. In this case the coupling of these phonons with the energy gap is also the subject of discussion.

The contribution by J. R. SANDERCOCK expresses still growing interest to investigate opaque materials via the Brillouin scattering. The important feature of such scattering are the complex wave vectors because of the radiation damping. The contribution introduces into the experimental techniques in this field (multipass and synchronously scanned tandem Fabry-Pérot interferometers) as well as into modes and object visible in the process of scattering (bulk and surface spin waves, duffusive excitations, ripples).

In the last contribution to this volume by G. WEISS and R. G. ULBRICH the influence of coupled exciton-photon modes, i.e., excitonic polaritons on, mainly, resonant light scattering is studied. These excitations, being highly theoretical constructions till 1972, have shown their almost ubiquitous character in semiconductor optical experiments. In the contribution the resonant scattering versus hot luminescence controversy is discussed, as well as exciton polariton-mediated electronic scattering. Moreover, the role of additional boundary condition (ABC) in these effects is particularly emphasized.

In order to close the topics of the present three-parts edition, the contributions to the forthcoming volume together with their authors are worth listing. This part will be published in 1983 by the same editors and will be devoted mainly to the new scattering mechanismus in solids. It will contain the contributions about fre-carrier excitations in doped semiconductors (G. Abstreiter, M. Cardona, A. Pinczuk), spin-dependent scattering in CdS (Geschwind, R. Romestein) and in magnetic semiconductors (G. Güntherodt, R. Zeyher), microscopic description of light scattering in valence-fluctuating rare earth compounds (G. Guntherodt, R. Merlin) and about surface enhanced Raman scattering. Moreover, the volume will give a summary on morphic effects (e. g., effects of hydrostatic or uniaxial pressure on phonons and electrons) by B. M. Weinstein and R. Zallen.

The reported volumes cover almost the whole field of light scattering phenomena in solids. Their contributors are the best specialists in the particular sub-fields. The exposition of the topic is rather transparent, which is supported by a variety of properly chosen illustrations. The book is addressed mainly to experimental physicists working on the light scattering phenomena; for them these books are rather indispensable. On the other hand, also theorists or other physicists will find in these volumes a lot of interesting information and ideas; the construction of the book is very helpful in looking for these information. Let us add that some parts of the book can be interesting also for specialists in many branches of natural sciences from lite sciences to chemistry and ecology

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Integrated Optics: Theory and Technology

ROBERT G. HUNSPERGER

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[pp. i–xiv + 299, with 167 Figures]

This book is an introduction to the new but dynamically growing field – integrated optics. Integrated optics is the name of opto-electronic systems in which the wires are replaced by light – waveguiding optical fibres, conventional integrated circuits being replaced by optical integrated circuits.

The book has been planned as a textbook on an integrated optics. The first Chapter gives a review of the basic principles of integrated optics. The next chapters are devoted to the theory and technology of the following devices: optical waveguides, couplers, optical modulators, and semiconductor laser diodes. The last Chapter deals with the applications of integrated optical devices and systems, as well as with trends in this field.

The presentation of the integrated optics problems in the book is balanced, calling the reader's attention to the theory, technology, and applications of optical integrated circuits. The book is well-written, derivations are clear, references adequate and properly selected.

This book may be useful not only for the students as a textbook on integrated optics, but may also serve as a helpful manual for the scientists and engineers inteferstед in the field of integrated optics.

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