Inverse Raman Effect (TIRE), the Raman Induced Kerr Effect (TRIKE), stimulated Raman gain (SRG), and Four Wave Mixing (FWM). Attention is given to wave vector matching and symmetry considerations, and applications to combustion diagnostics and nonlinear susceptibility measurement are discussed in the conclusions.

Chapter 5 describes another round of nonlinear techniques based on multiphoton absorption. Two- and three-photon absorption spectroscopy is described first, followed by multiquantum ionization. The latter is isotopically selective and finds important application in laser isotope separation. The nonlinear polarization due to multiquantum absorption naturally leads to a radiation field which is responsible for nonlinear mixing. This topic is discussed in detail. Then Four Wave Mixing and autoionization resonance as well as resonance ionization spectroscopy are described. The latter technique can detect one atom of resonant species in a background of 10^{19} of nonresonant atoms. Application of multiquantum absorption to Resonance Ionization Mass Spectrometry (RIMS) and Rydberg atom production is mentioned in the concluding section.

Optical Coherent Transients is the topic of Chapter 6. By analogy to pulsed NMR methods, the similarity between a two-level atom and a magnetic spin one-half system has been exploited to develop various time-dependent optical techniques. The discussion begins with Free Induction Decay (FID) and optical nutation. Then, the Photon Echo (PE) is described in the framework of the Bloch Vector picture as an example of rephasing phenomena. Two- and three-pulse (STIMULATED) photon echoes are discussed in depth and their use in such diverse applications as studies of atomic and molecular collisions and in optical data storage and retrieval are described. Finally, related phenomena such as Ramsey resonances (Raman induced and three field) are treated.

The final chapter describes nonlinear frequency generation techniques for producing tunable sources. Second harmonic generation and sum frequency generation are treated first, where it pointed out how the birefringence in some systems can be used to achieve phase matching. Then, higher order sum and harmonic generation are discussed. Finally, the generation of incoherent (spontaneous anti-Stokes) XUV radiation is discussed and its application to spectroscopy is described. The concluding section focuses on infrared spectrophotography using broadband infrared radiation generated by stimulated Raman scattering.

This text exposes the reader to a wide variety of nonlinear optics phenomena and applications and provides an introduction and access to the literature which undoubtedly which be useful for years to come. There are a few notable omissions, such as the semiclassical treatment of superradiance. However, this is expected in covering a field of such diversity. A nice feature of this work, in addition to its content, is the pleasant sense of humor of the authors, who disavow all responsibility for the future of workers still using the first edition, and who refer to coherent ordinary Raman spectroscopy as COORS. We can only hope that someday, a technique called DOS EQUIS will be devised.

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Plasma Diagnostics: Volume 2 of Surface Analysis and Interactions

Edited by O. Auciello and D.L. Flamm
Academic Press, 1989, 327 pages.
ISBN: 0-12-067636-2

Surface Analysis and Interactions contains six reviews of techniques used to characterize surfaces exposed to plasmas. It complements the first volume of *Plasma Diagnostics* which covered optical, electrical and mass spectrometric plasma diagnostic techniques. The chapters of the present volume cover: (1) the application of quartz crystal microbalances to studies of plasma-surface interactions, (2) the elemental analysis of treated surfaces by electron and ion spectroscopies, (3) spectroscopic ellipsometry in plasma processing, (4) ion beam analysis of plasma-exposed surfaces, (5) the interpretation of plasma probe data in fusion experiments, and (6) the use of nondestructive photoacoustic and photothermal techniques for the study of plasma-exposed surfaces.

This is a useful introductory reference book for workers in plasma-based etching and deposition, surface modifications and fusion. Each chapter contains an elementary discussion of the fundamentals of the techniques covered, a brief description of the instrumentation, the capabilities and the technical problems associated with using these techniques for plasma surface diagnostics, and reviews of examples. All chapters contain a large number of references, making the book a valuable starting point to the literature of the topics covered up to about 1987.

One of the book's shortcomings was that it did not contain a chapter discussing emerging surface diagnostic techniques for plasmas. This is currently a very active area motivated by the perceived shortcomings of current approaches. The goal of these novel techniques is to study plasma-surface interactions in real-time rather than through post-plasma surface analysis, to achieve spatial resolution or three-dimensional analysis rather than large area blanket analysis, etc. A discussion of these topics would have enhanced this text.

Overall, the book is a very good compilation of authoritative review chapters on current uses of surface sensitive probes to plasma diagnostics. Plasma science and technology are highly interdisciplinary fields, and this book provides interesting different perspectives on how to approach the study of a surface interacting with a plasma. It should serve as a good starting point for physicists, chemists or materials scientists who would like to become familiar with this area.

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