

# **Coherent Raman Spectroscopy**

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# COHERENT RAMAN SPECTROSCOPY

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*At midnight on January first of every year, the coherent Raman physicists have conspired to permute the acronyms for these techniques . . . just to keep the chemists confused.*

**M.D.L., Stanford, CA (1976)**

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## PREFACE

Physical and chemical spectroscopists rely on several optical techniques for studying the fundamental excitations of matter: i.e. optical absorption, emission and scattering. The inelastic light scattering spectroscopies deal with the study of electronic states (molecular or atomic) which are inaccessible by normal linear absorption or emission spectroscopy due to parity considerations. Those techniques which determine the energies and magnitudes of dipole forbidden transitions are commonly referred to as Raman spectroscopy. The advent of tunable lasers has recently drawn widespread attention to a number of nonlinear Raman spectroscopic techniques which yield enhanced capabilities relative to older linear techniques. My objective in writing this monograph is to provide a unified and general presentation of the fundamental aspects of nonlinear Raman spectroscopy, or coherent Raman spectroscopy.

The purpose of this monograph is: (1) to provide the theoretical basis from which coherent Raman spectroscopy developed; (2) to present a consistent description and comparison of the most useful of the presently available techniques; (3) to survey the applications and utility of coherent Raman spectroscopy. Emphasis is placed on a review and description of several coherent Raman techniques and their implementation. Experimental data which typifies each technique is given, in addition to a comparative analysis which clarifies the advantages and disadvantages of each technique. A detailed preview of the monograph may be found in Chapter 1.

This monograph was written primarily for the uninitiated or endeavoring coherent Raman spectroscopist. Although some review books contain specialized chapters dealing with a segment of the field, the vast body of information is scattered in various journals and conference proceedings. Thus, this work should serve as the first unified and comprehensive review of coherent Raman spectroscopy and it will provide a reference point for experienced industrial and academic researchers alike.

The field of coherent Raman spectroscopy continues to rapidly advance and as such the author does not presume to be an authority on the subject. Thus I welcome all criticisms, corrections and recommendations, and apologize for errors and omissions.