

## Time-resolved spectroscopy

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*Time-Resolved Vibrational Spectroscopy*. Eds. A. Laubereau and M. Stockburger. Springer-Verlag, Berlin; Heidelberg; New York; Tokyo, 1985, pp. 302 (Springer Proceedings in Physics, V. 4).

The fourth volume of the Springer Proceedings in Physics contains materials of the second International Conference on the application of time-resolved spectroscopy to the investigation of the dynamics of vibrations of molecules in a solid, in matrices, in liquids and in solutions, which took place 3–7 June 1985 in the FRG. The first conference devoted to the same subject took place in 1982 in the USA.

With the appearance in laboratory practice nearly two decades ago of picosecond, subpicosecond, and recently femtosecond light pulses it has turned out to be possible by utilizing certain nonlinear optical phenomena to create a new direction of experimental investigations of rapidly occurring processes of different physical nature. In particular, a new independent direction has been created—time-resolved vibrational spectroscopy. In it to the spectral resolution there was added the very effective study of time-dependent processes with a high degree of time-resolution.

The book under review presents materials which the editors of the volume divided into two classes or directions.

the first group of investigations is based on the fact that a short light pulse excites one particular vibration of a molecule (mode), while another short pulse is used by means of a delay line to observe the behavior of the excited mode in time, and this determines the relaxation time of the process which characterizes the excited mode. In the other group of investigations the molecules are excited (pumped) in such a manner that they turn out to be in an unstable or transitional—intermediate—short-lived state, such as, for example, radicals, conformational isomers, etc.

The book, in addition to the introduction, contains 59 articles authored primarily by physicists from the USA, Canada, England, France, and FRG. Our country is represented by a single article. The entire material is broken up according to its subject matter into seven parts.

The first part contains articles of primarily methodological nature describing experimental arrangements and experimental techniques and the application of these new techniques to different physical and physico-chemical problems. In particular, a description is given of the method of high resolution Fourier-spectroscopy of Raman scattering of light utilizing ultrashort light pulses and of the technique of measuring third order electron susceptibility of GaP by

the method of picosecond CARS-spectroscopy.

The second (dynamics of molecular vibrations) and the third (dynamics of vibrations of solids) parts contain abundant experimental materials on different aspects of redistribution of energy over the vibrational degrees of freedom in molecules and the dissipation of energy in polyatomic molecules in solutions, of ultrarapid dynamics of vibrations in dye molecules, and of relaxation processes in solid benzene. The highly sensitive method of time-resolution has been applied to the study of coherent and parametric unstable two-phonon states and of many other questions.

The fourth (photochemical reactions) and the fifth (transitional states) parts contain articles devoted to the study of resonance Raman scattering of light in the case of photochemical reactions in solutions, the application of resonance CARS to study the short-lived radicals and photoisomers, the intramolecular kinetics of vibrations of excited

singlet and triplet states in some hydrocarbons, etc.

The sixth part (biological systems) contains 13 articles of biophysical and biochemical nature. Among them are the application of resonance Raman scattering of light to the study of reactions in nonequilibrium enzymes, of the kinetics of bacteriorhodopsin and the role played by water in bacteriorhodopsin, to the study of relaxation processes in biological media, the application of time-resolved spectroscopy to the study of photobiological systems, and other articles.

Finally, the seventh part (theoretical aspects) contains interpretation of the results obtained and new theories.

The new direction in optics—the spectroscopy of rapidly occurring processes—has already brought many interesting and important results inaccessible to the previous methods of investigating gases, solutions, liquids and solids, and undoubtedly, the development of this field will provide many more significant results.