Preface

The investigation of liquid properties is as old as the human desire to observe natural phenomena. The paramount relevance of such state of matter is obvious, spanning from the basic theoretical model of random systems to the more advanced technical applications. Nevertheless the interpretation and understanding of liquid properties remains a challenge in materials science.

In the liquid state, the potential and kinetic energies are characterized by similar values, differently from the gas or solid/crystal phases. This fundamental physical property prevents a description of the liquid structure independently from its dynamics. The intermolecular forces and molecular motions are strictly interconnected, producing the peculiar features of liquid phases.

In particular when the intermolecular potential is characterized by specific features, as anisotropic and/or long-range interactions, the liquid state shows local dynamic aggregation and structuring phenomena. This is the distinguishing characteristic of *complex liquids*. Typical examples are the hydrogen-bonded liquids, glass formers, polymers and liquid crystals. Also relatively simple molecular liquids, e.g., CS_2 and benzene, clearly show complex dynamics, evidence of local structuring effects.

During the last years, researchers have undertaken a steady effort to improve the knowledge of liquid matter, both from experimental and theoretical points of view. New spectroscopic techniques, based on nonlinear optical phenomena, have been realized and applied to the study of simple molecular liquids. On the other hand, standard experiments have been applied to liquids characterized by particularly complex dynamic processes.

In this book, we collect a series of chapters dedicated to the state-of-art studies of optical spectroscopy in the time domain on complex liquids of different nature. In Chap. 1, a new nonlinear spectroscopic technique, 2D-Raman, is comprehensively reviewed. This is probably the most promising experimental tool able to collect truly new information on fast dynamics in liquid matter. Chapter 2 is dedicated to optical Kerr effect techniques and to the investigation of relaxation dynamics in complex liquids, inclusive of relative slow collective phenomena. Transient grating spectroscopy is reviewed in Chap. 3, introducing the recent experimental improvements and their application to the study of viscoelastic phenomena in glass formers. Chapter 4 describes the dynamics of confined liquid crystals as measured by dynamic light scattering experiments. In Chap. 5, the host–guest interactions of dye molecules in liquid-crystal matter is analyzed by time-resolved fluorescence and dichroism spectroscopy.

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