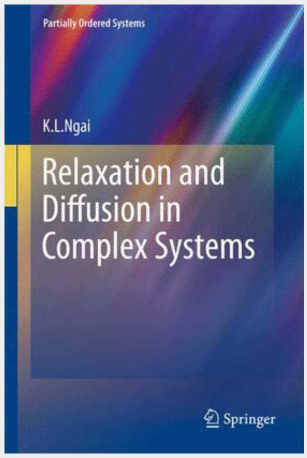
Ngai

Relaxation and Diffusion in Complex Systems

Relaxation and diffusion are general and common phenomena in many branches of condensed matter physics, chemistry and materials sciences. In disordered and partially ordered systems the classes of materials include liquids, colloids, polymers, rubbers, plastic crystals, biomolecules, ceramics, electrolytes, fuel cell materials, molten salts, glasses, and etc. Each class is further subdivided into many different types of materials. For example, glasses vary from metallic glasses, oxide glasses, chalcogenide glasses, polymeric and organic glasses, and each form a separate discipline. In past years research has suffered from undue fragmentation in terms of individual classes of materials. Dr. Ngai was one of the few who recognized the existence of a remarkable universality of relaxation and diffusion properties across the diverse classes of materials, and he suggested that some yet undiscovered fundamental physics is behind this universality Beginning in 1979 with the publication of two articles in Comment Solid State Physics, Dr. Ngai launched an interdisciplinary study of relaxation and diffusion that has continued to the present. At this time, experimental evidence of universal behavior are plentiful and well substantiated. Dr. Ngai has also created a theoretical framework to characterize, correlate and interpret these universal properties. This book will be of interest to a large number of researchers across many disciplines.

Relaxation and Diffusion in Complex Systems comprehensively presents a variety of experimental evidences of universal relaxation and diffusion properties in complex materials and systems. The materials discussed include liquids, glasses, colloids, polymers, rubbers, plastic crystals and aqueous mixtures, as well as carbohydrates, biomolecules, bioprotectants and pharmaceuticals. Due to the abundance of experimental data, emphasis is placed on glass-formers and the glass transition problem, a still unsolved problem in condensed matter physics and chemistry. The evidence for universal properties of relaxation and diffusion dynamics suggests that a fundamental physical law is at work. The origin of the universal properties is traced to the many-body effects of the interaction, rigorous theory of which does not exist at the present time. However, using solutions of simplified models as guides, key quantities have been identified and predictions of the universal properties generated. These predictions from Ngai's Coupling Model can qualitatively as well as quantitatively explain the experimentally observed dynamic properties of different complex interacting materials and systems in many cases, essentially from the strength of the interaction. Change of relaxation and diffusion dynamics when dimension of the material is reduced to nanometer scale are consistent with the predictions. The success of the Coupling Model provides some measure of understanding the relaxation properties of complex interacting systems and also paves the way for the construction of rigorous theories in the future. Relaxation and Diffusion in Complex Systems describes advances that affect many different areas of research, and will be of particular interest to those working in the fields of materials science, nanotechnology, energy and medicine.



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