

# Introduction To Polymer Physics

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publisher description

this book is a concise textbook on polymer physics for graduate students researchers in physics physical chemistry and chemical engineers who are interested in complex fluids can also benefit from the book

modern polymer materials are designed by applying principles of correlation between chemical structure physical macrostructure and technological properties fundamentals of polymer physics are explained in this book without excessive use of calculations four main sections treat relaxation of polymers melting and crystallization the mechanism of deformation in thermoplastics elastomers and multiphase systems and thermodynamics of mixing and swelling of polymers and polymer networks the book presents the theoretical models of polymer physics in a comprehensive style and relates their applicability to real polymer systems in terms of the available experimental observations

this textbook provides a concise and transparently structured one semester course in polymer physics the science in addition to polymer chemistry behind a class of ubiquitous materials it covers all major theoretical concepts and their applications in six chapters including the conformations of chains the thermodynamics of mixtures solutions and networks and the dynamics of polymers selected topics highlight aspects of polymer mechanics the role of particulate fillers stable and labile liquid crystal polymers and polyelectrolytes solved problems deepen and extend important points that are explained in the main chapters the emphasis is on the derivation of the results and not on their mere presentation if a result can be obtained using different theoretical methods or viewed from a different angle an attempt is made to explain the relationships between the methods as clearly as possible in addition the validation of theoretical results through suitable experiments is always included all this assumes a certain familiarity with statistical thermodynamics and its mathematics which

means that the text is best suited for upper undergraduate level

this book is the result of my teaching efforts during the last ten years at the royal institute of technology the purpose is to present the subject of polymer physics for undergraduate and graduate students to focus the fundamental aspects of the subject and to show the link between experiments and theory the intention is not to present a compilation of the currently available literature on the subject very few reference citations have thus been made each chapter has essentially the same structure starting with an introduction continuing with the actual subject summarizing the chapter in 30d 500 words and finally presenting problems and a list of relevant references for the reader the solutions to the problems presented in chapters 1 12 are given in chapter 13 the theme of the book is essentially polymer science with the exclusion of that part dealing directly with chemical reactions the fundamentals in polymer science including some basic polymer chemistry are presented as an introduction in the first chapter the next eight chapters deal with different phenomena processes and states of polymers the last three chapters were written with the intention of making the reader think practically about polymer physics how can a certain type of problem be solved what kinds of experiment should be conducted this book would never have been written without the help of my friend and adviser dr anthony bristow who has spent many hours reading through the manuscript criticizing the content

this important book emphasizes the basic derivation of many key equations used in polymer physics phrases such as it can be easily shown that and it readily follows that seen in many textbooks are seldom used here the models assumptions and key equations underlying concepts are presented in the text details used in the derivations are given in the accompanying cd rom the cd rom also contains problems with solutions in many cases which test the reader s grasp of the material as well as a glossary of symbols contents introduction

historical background to polymer physics and description of polymer physics areas chain statistics the chain character of polymers modeled on probability considerations lattice theory of blending polymers thermodynamics classical and statistical thermodynamic models applied to polymers optics scattering diffraction birefringence applied to polymers electricity electrical background to conducting polymers polarizability spectroscopy infrared raman and fourier transform infrared spectroscopy rubber gaussian and non gaussian models of rubber elasticity crystallization nucleation growth and crystalline amorphous models polymer crystal morphology cd rom contents orientation techniques for measuring polymer orientation hermans orientation function viscoelasticity maxwell and voigt models of polymer viscoelasticity readership upper level undergraduates and graduate students in chemistry physics materials science and engineering scientists and engineers interested in polymers

polymer physics is a key part of macromolecular science this textbook presents the elements of this important branch of materials science in the style of a series of lecture the main focus lays on the concepts rather than on experimental techniques and theoretical methods written for graduate students of physics materials science and chemical engineering as well as for researchers in academia and industry entering this field the book introduces and discusses the basic phenomena that lead to the peculiar physical properties of polymeric systems after more than ten years since the first printing the time had come for a revision and expansion of the book s contents in addition to numerous minor modifications this third edition includes some major changes i a newly written chapter deals with conjugated polymers the physical basis of the characteristic electro optic response is explained and the spectacular electrical conduction properties of conjugated polymers created by doping are discussed ii polyelectrolyte solutions with their special properties caused by coulomb forces are newly treated in different chapters of the book dealing with ordering phenomena viscous effects and the superswelling of gels iii since the basic understanding of melt crystallization has greatly changed during the last

decade the corresponding chapter was rewritten it presents the new findings and interprets the discovered laws

a molecular view on the fundamental issues in polymer physics is provided with an aim at students in chemistry chemical engineering condensed matter physics and material science courses an updated translation by the author a renowned chinese chemist it has been proven to be an effective source of learning for many years up to date developments are reflected throughout the work in this concise presentation of the topic the author aims at presenting the subject in an efficient manner which makes this particularly suitable for teaching polymer physics in settings where time is limited without having to sacrifice the extensive scope that this topic demands

polymer physics provides an introduction to the field for upper level undergraduates and first year graduate students any student with a working knowledge of calculus physics and chemistry should be able to read this book the essential tools of the polymer physical chemist or engineer are derived in this book without skipping any steps

providing a comprehensive review of the state of the art advanced research in the field polymer physics explores the interrelationships among polymer structure morphology and physical and mechanical behavior featuring contributions from renowned experts the book covers the basics of important areas in polymer physics while projecting into the future making it a valuable resource for students and chemists chemical engineers materials scientists and polymer scientists as well as professionals in related industries

this book is an introductory textbook on the statistical mechanics of polymers and complex fluids aimed at senior undergraduate and graduate students and non specialist researchers who are starting research in this field modern statistical mechanics on polymers and complex

fluids is based on many fields such as chemical physics statistical mechanics quantum mechanics stochastic processes theory of phase transitions hydrodynamics rheology and so on this book provides an overview of the basic concepts and methods used in current research on the physics of polymers and complex fluids using simple but essential examples we describe how to derive the physical properties of polymers theoretically focusing on the structure and dynamics on mesoscopic scales here the term mesoscopic scales means intermediate lengths and time scales between the microscopic atomic scale and the macroscopic scale properties on mesoscopic scales are the central issue of the physics of polymers and complex fluids because these materials are well characterized by spatiotemporal structures on these scales where we can extract universal properties that are independent of the microscopic details of the system

the first stage of the physics of long flexible chains was pioneered by eminent scientists such as debye kuhn kramers and flory who formulated the basic ideas in recent years because of the availability of new experimental and theoretical tools a second stage of the physics of polymers has evolved in this book a noted physicist explains the radical changes that have taken place in this exciting and rapidly developing field pierre gilles de gennes points out the three developments that have been essential for recent advances in the study of large scale conformations and motions of flexible polymers in solutions and melts they are the advent of neutron scattering experiments on selectively deuterated molecules the availability of inelastic scattering of laser light which allows us to study the cooperative motions of the chains and the discovery of an important relationship between polymer statistics and critical phenomena leading to many simple scaling laws until now information relating to these advances has not been readily accessible to physical chemists and polymer scientists because of the difficulties in the new theoretical language that has come into use professor de gennes bridges this gap by presenting scaling concepts in terms that will be understandable to students in chemistry

and engineering as well as in physics

here herbert baur provides a simple description of the theory of thermophysics of polymers in order to illustrate the theoretical skeleton he only treats the simple easily comprehensible problems of polymer physics yet in detail the main points covered are thermally excited conformation isomery of polymers phonon gas of ideal polymer crystals the dissipative thermo mechanical behaviour of polymers new aspects of viscoelastic behavior glass transistion and crystallization

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