Crystallization Behavior Of Pet Materials

"Thermal Analysis of Polymeric Materials" systematically treats macroscopic measurements by thermal analysis and the quantitative link to microscopic, molecular structure and mobility. Reversible and irreversible thermodynamics, kinetics, quantum mechanics, and statistical thermodynamics are the roots of the described thermal analysis. The book aims to broaden readers' understanding of materials and the connection of flexible macromolecules (polymers) to small molecules and rigid macromolecules (minerals, salts, and metals). An effort is made to discover how the long, flexible molecules fit into their small phases which are characterized as microphases or nanophases. Their order ranges from amorphous to mesophase-like and crystalline. Ultimately, it is shown that the basic structure-property-processing triangle is connected to the better-known types of molecules and their common macroscopic phases.

Proceedings of the Third International Conference on Frontiers of Polymers and Advanced Materials held in Kuala Lumpur, Malaysia, January 16-20, 1995

The degradation of plastics is most important for the removal and recycling of plastic wastes. The book presents a comprehensive overview of the field. Topics covered include plastic degradation methods, mechanistic actions, biodegradation, involvement of enzymes, photocatalytic degradation and the use of cyanobacteria. Also covered are

the market of degradable plastics and the environmental implications. Keywords: Degradable Plastics, Bioplastics, Biodegradable Plastics, Enzymes, Cyanobacteria, Photocatalytic Degradation, Wastewater Treatment, Degradable Plastic Market, Polyethylene, Polypropylene, Polystyrene, Polyvinyl Chloride, Polyurethane, and Polyethylene Terephthalate.

Polyethylene terephthalate (PET) is a semicrystalline polymer widely used for production of fibers, films and containers. The polymer is obtained from the reaction of ethylene glycol (EG) and terephthalic acid (PTA) in a two stage process involving esterification and polycondensation reactions. Historically, the raw materials have been obtained from petro sources through refining of oil. To alleviate the dependence on fossil energy resources, researchers have synthesized EG and PTA starting from biomass. The use of these bio monomers depends on their suitability to polymerization requirements and the quality of the polymer that can be produced. In this research, PET was synthesized using both monomers obtained from a bio based source. Bio EG was obtained with a high purity and was used as received. Bio PTA was produced through a modified Amoco process using bio p-xylene separated through distillation and crystallization methods from a sample containing furans, aromatics and alkanes. The analysis of the separation methods revealed that the side products present in the bio p-xylene sample do not have equilibrium limitations that prevent their removal through physical separation methods. Bio p-xylene was obtained with purity enough to be

considered a high grade product (~99.8%), Low concentration impurities in the form of alkanes and a furan molecule were still present in the product. The analysis of the production of PTA revealed that the furan impurity present in bio p-xylene did not oxidize under Amoco process conditions, the furan was recovered from the reaction media in the oxidation liqueur. When compared to the use of petro p-xylene, the PTA produced had similar characteristics evaluated through color measurements, optical density and product purity. Both materials were produced with concentration of monofunctional groups low enough for their use in the polymerization reaction. In order to disclose the effect on polymerization of using bio derived monomers, the analyses of product composition, thermal stability, crystallization behavior and physical properties were done. It was found that when the purity of the bio derived monomers is comparable to that of a petro product a polymer with similar characteristics was obtained. Based on the characteristics of the polymers produced, there was no assignable difference to the use of either set of raw materials.

The classical view on polymer crystallization basically focused on the expla- tion of a few macroscopically observable parameters like the thickness of the resulting lamellar structure and the corresponding growth rates. However, the emerging paradigm for the description of chain crystals is too simple and cannot account for the complex non-equilibrium processes responsible for structure f- mation on various levels, ranging from the nanometer up to the millimeter scale. This complexity detected by several novel

experimental results led to a renewed interest in this ”old” topic of polymer crystallization. These new ?ndings c- cern the early stages of the crystallization process, crystal formation in con?ned geometries like ultra-thin ?lms and the competition between (micro)phase s- aration and crystallization in copolymers and blends. In particular, high spatial resolution techniques such as atomic force microscopy provided deeper insight into the molecular organization of crystallizable polymers. Computer simu- tions based on microscopic processes were used to improve our understanding of how polymer crystals are nucleated and how they grow. New ideas emerged about possible multistage pathways which are followed during the formation of polymer lamellae. The importance and the consequences of the non-equilibrium character of polymer crystals got signi?cantly more attention. Links and ana- gies to growth phenomena and pattern formation in general are being developed. However, these ideas are still subject of intensive and controversial discussions.

Selected, peer reviewed papers from the 3rd International Conference on Advanced Engineering Materials and Technology (AEMT 2013), May 11-12, 2013, Zhangjiajie, China

The use of reactive polymers enables manufacturers to make chemical changes at a late stage in the production process—these in turn cause changes in performance and properties. Material selection and control of the reaction are essential to acheive optimal performance. The second edition of Reactive Polymers Fundamentals and

Applications introduces engineers and scientists to the range of reactive polymers available, explains the reactions that take place, and details applications and performance benefits. Basic principles and industrial processes are described for each class of reactive resin (thermoset), as well as additives, the curing process, and applications and uses. The initial chapters are devoted to individual resin types (e.g. epoxides, cyanacrylates, etc.); followed by more general chapters on topics such as reactive extrusion and dental applications. Material new to this edition includes the most recent developments, applications and commercial products for each chemical class of thermosets, as well as sections on fabrication methods, reactive biopolymers, recycling of reactive polymers, and case studies. Injection molding of reactive polymers, radiation curing, thermosetting elastomers, and reactive extrusion equipment are all covered as well. Most comprehensive source of information about reactive polymers Covers basics as well as most recent developments, including reactive biopolymers, recycling of reactive polymers, nanocomposites, and fluorosilicones Indispensable guide for engineers and advanced students alike—providing extensive literature and patent review

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Filling the gap for a reference dedicated to the characterization of polymer blends and their micro and nano morphologies, this book provides comprehensive, systematic coverage in a one-stop, two-volume resource for all those working in the field. Leading researchers from industry and academia, as well as from government and private research institutions around the world summarize recent technical advances in chapters devoted to their individual contributions. In so doing, they examine a wide range of modern characterization techniques, from microscopy and spectroscopy to diffraction, thermal analysis, rheology, mechanical measurements and chromatography. These methods are compared with each other to assist in determining the best solution for both fundamental and applied problems, paying attention to the characterization of nanoscale miscibility and interfaces, both in blends involving copolymers and in immiscible blends. The thermodynamics, miscibility, phase separation, morphology and interfaces in polymer blends are also discussed in light of new insights involving the nanoscopic scale. Finally, the authors detail the processing-morphology-property relationships of polymer blends, as well as the influence of processing on the generation of micro and nano morphologies, and the dependence of these morphologies on the properties of blends. Hot topics such as compatibilization through nanoparticles, miscibility of new

biopolymers and nanoscale investigations of interfaces in blends are also addressed. With its application-oriented approach, handpicked selection of topics and expert contributors, this is an outstanding survey for anyone involved in the field of polymer blends for advanced technologies.

In the context of polymer crystallization there are several still open and often controversially debated questions. The present volume addresses issues such as novel general views and concepts. It presents new ideas in a connected and accessible way. The intention is thus not only to provide a summary of the present state-of-the-art to all active works but to provide an entry point to newcomer and graduate students entering the field.

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This proceedings book presents the main findings of the 13th International Seminar on

Polymer Science and Technology (ISPST 2018), which was held at Amirkabir University of Technology, Tehran, on November 10–22, 2018. This forum was the culmination of more than three decades of academic and industrial activities of Iranian scholars and professionals, and the participation of many notable international scientists, in covering various important polymer-related subjects of concern to Iran and the world at large, including polymer synthesis, processing and properties, as well as issues concerning polymer degradation, stability, and environmental aspects. For the past half a century, the growing concern for advancing human health, quality of life, and – especially in the last few decades – avoiding and combating environmental pollution have shaped and driven scientific activities geared toward the creation of smart materials that are compatible with the human body, and have prompted scientists and technologists to pursue research using natural and sustainable sources. This book highlights efforts to responsibly address the problems caused by, and which can potentially be solved by, polymers and plastics.

Accurate constitutive modeling of polymeric fibers presents a difficult and distinct challenge. While significant progress has been made in constructing models applicable for small strains and limited strain-rate and temperature regimes, much less has been made for more general conditions. This is due in part to the complexity of polymeric behavior. In this work, experimental results of uniaxial extension tests on Polyethylene terephthalate (PET) were obtained from Dr. S. Bechtel, were analyzed, and were formulated into a new model which explains the behavior of PET at different temperatures and strains. The biggest impediment in the determining the behavior of polymeric was the difference in the behavior of PET above and below its glass transition temperature. Consequently, well established (from microstructural

considerations) constitutive models and concepts for rubber elasticity and plasticity were not directly transferable to modeling PET fibers. In the model, the PET fibers were assumed to be constituted by amorphous and crystallization segments and the response of the material during stretching was the combined response of simultaneous stretching of the amorphous and the crystalline segments. The strengthening mechanism is due to orientation of the amorphous segments during stretching. The model involves a friction element which took account of the plastic behavior below the glass transition temperature. The model was used to predict the response of PET at different temperatures and the results from the model showed good agreement with the experimental data. The results from the research will be further used to increase the overall efficiency of the fiber drawing process.

The presently common practice of wastes' land-filling is undesirable due to legislation pressures, rising costs and the poor biodegradability of commonly used materials. Therefore, recycling seems to be the best solution. The purpose of this book is to present the state-of-the-art for the recycling methods of several materials, as well as to propose potential uses of the recycled products. It targets professionals, recycling companies, researchers, academics and graduate students in the fields of waste management and polymer recycling in addition to chemical engineering, mechanical engineering, chemistry and physics. This book comprises 16 chapters covering areas such as, polymer recycling using chemical, thermo-chemical (pyrolysis) or mechanical methods, recycling of waste tires, pharmaceutical packaging and hardwood kraft pulp and potential uses of recycled wastes.

Bio-nanotechnology is the key functional technology of the 21stcentury. It is a fusion of biology and nanotechnology based on theprinciples and chemical pathways of living

organisms, and refers tothe functional applications of biomolecules in nanotechnology. Itencompasses the study, creation, and illumination of theconnections between structural molecular biology, nutrition andnanotechnology, since the development of techniques ofnanotechnology might be guided by studying the structure andfunction of the natural nano-molecules found in living cells.Biology offers a window into the most sophisticated collection offunctional nanostructures that exists. This book is a comprehensive review of the state of the art inbio-nanotechnology with an emphasis on the diverse applications infood and nutrition sciences, biomedicine, agriculture and otherfields. It describes in detail the currently available methods andcontains numerous references to the primary literature, making thisthe perfect “field guide” for scientists who want toexplore the fascinating world of bio-nanotechnology. Safety issuesregarding these new technologies are examined in detail. The book is divided into nine sections – an introductorysection, plus: Nanotechnology in nutrition and medicine Nanotechnology, health and food technology applications Nanotechnology and other versatile applications Nanomaterial manufacturing Applications of microscopy and magnetic resonance innanotechnology Applications in enhancing bioavailability and controllingpathogens Safety, toxicology and regulatory aspects Future directions of bio-nanotechnology The book will be of interest to a diverse range of readers inindustry, research and academia, including biologists, biochemists,food scientists, nutritionists and health professionals.

Collection of selected, peer reviewed papers from the 3rd Asian Pacific Conference on Mechanical Components and Control Engineering (MCCE 2014), September 20-21, 2014, Tianjin, China. Volume is indexed by Thomson Reuters CPCI-S (WoS). The 367 papers are grouped as follows: Chapter 1: Materials Science and Processing Technologies, Chapter 2: General Mechanical Engineering, Applied Mechanics and Dynamics, Chapter 3: Mechatronics and Robotics, Chapter 4: Control Technologies, Automation, Design and Simulation of Manufacturing, Chapter 5: Electrical Engineering and Electric Machines, Chapter 6: Power System and Energy Engineering, its Applications, Chapter 7: Electronics and Integrated Circuits, Embedded Technology and Applications, Chapter 8: Measurements, Testing, Monitoring, Analysis and Methodology, Chapter 9: Signal and Image Processing, Data Mining and Computational Mathematics, Chapter 10: Communication, Networks and Information Technologies, Chapter 11: Construction Technologies, Urban Planning and Urban Traffic, Chapter 12: Earth Science and Environmental Engineering, Chapter 13: Biomedical Engineering, Chapter 14: Product Design, Planning, Projects Management and Industrial Engineering

This book is a result of contributions of experts from international scientific community working in different aspects of nanocomposite science and applications and reports on the state of the art research and development findings on nanocomposites through original and innovative research studies. Through its 19 chapters the reader will have

access to works related to the theory, and characterization of various types of nanocomposites such as composites of cellulose and metal nanoparticles, polymer/clay, polymer/Carbon and polymer-graphene nanocomposites and several other exciting topics while it introduces the various applications of nanocomposites in water treatment, supercapacitors, green energy generation, anticorrosive and antistatic applications, hard coatings, antiballistic and electroconductive scaffolds. Besides, it reviews multifunctional nanocomposites, photonics of dielectric nanostructures and electron scattering in nanocomposite materials.

Volume is indexed by Thomson Reuters CPCI-S (WoS). This special volume addresses the hottest topics in various aspects of the field of emerging materials and mechanical applications. It covers a wide range of themes in this area, including Industrial Materials, Mechanics Applications, Material Engineering, Applied Mechanics for Materials, Applied Materials, etc. Researchers in the field will find herein a wealth of cutting-edge information.

An authoritative reference on the processing and finishing of polymeric materials for scientists and practitioners Owing to their versatility and wide range of applications, polymeric materials are of great commercial importance. Manufacturing processes of commercial products are designed to meet the requirements of the final product and are influenced by the physical and chemical properties of the polymeric material used. Based on Wiley's renowned Encyclopedia of Polymer Science and Technology,

Processing and Finishing of Polymeric Materials provides comprehensive, up-to-date details on the latest manufacturing technologies, including blending, compounding, extrusion,molding, and coating. Written by prominent scholars from industry, academia, and research institutions from around the globe, this reference features more than forty selected reprints from the Encyclopedia as well as new contributions, providing unparalleled coverage of such topics as: Additives Antistatic agents Bleaching Blowing agents Calendaring Casting Coloring processes Dielectric heating Electrospinning Embedding Processing and Finishing of Polymeric Materials is an ideal resource for polymer and materials scientists, chemists, chemical engineers, materials scientists, process engineers, and consultants, and serves as a valuable addition to libraries of chemistry, chemical engineering, and materials science in industry, academia, and government.

Practical and affordable, thermoplastics account for more than 90 percent of all plastic materials manufactured. That so many varieties are now available, speaks to the idea that while there is no one perfect material, it is possible to find a material that fits for every application. However, selecting that right material is no small challenge.Ans SPE/ANTEC 1997 ProceedingsCRC PressMaterial Characterization and Modeling of Strain Induced Crystallization in PET Above the Glass Transition Temperature

Volume is indexed by Thomson Reuters CPCI-S (WoS). The studies presented in this book cover the topics of: composites, micro/nano-materials and equipment, alloy materials, steel,

polymer materials, optical/electronic/magnetic materials, energy materials and new energy technology, environmentally-friendly materials and waste utilization, biomaterials and preparation technology, thin films, structural materials and earthquake-resistant structures, functional materials, surface-engineering/coatings, modeling, analysis and simulation, materials processing technology, laser-processing technology, mechanical behavior and fracture, tooling testing and evaluation of materials, thermal engineering theory and applications, detection and control technology.

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PEEK biomaterials are currently used in thousands of spinal fusion patients around the world every year. Durability, biocompatibility and excellent resistance to aggressive sterilization procedures make PEEK a polymer of choice, replacing metal in orthopedic implants, from

spinal implants and hip replacements to finger joints and dental implants. This Handbook brings together experts in many different facets related to PEEK clinical performance as well as in the areas of materials science, tribology, and biology to provide a complete reference for specialists in the field of plastics, biomaterials, medical device design and surgical applications. Steven Kurtz, author of the well respected UHMWPE Biomaterials Handbook and Director of the Implant Research Center at Drexel University, has developed a one-stop reference covering the processing and blending of PEEK, its properties and biotribology, and the expanding range of medical implants using PEEK: spinal implants, hip and knee replacement, etc. Covering materials science, tribology and applications Provides a complete reference for specialists in the field of plastics, biomaterials, biomedical engineering and medical device design and surgical applications

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available at http://www.ScholarlyEditions.com/.

This book provides an in depth and unparalleled presentation of the compositions of virtually all polymer blends.

Presents the state of the technology, from fundamentals to new materials and applications Today's electronic devices, computers, solar cells, printing, imaging, copying, and recording technology, to name a few, all owe a debt to our growing understanding of the photophysics and photochemistry of polymeric materials. This book draws together, analyzes, and presents our current understanding of polymer photochemistry and photophysics. In addition to exploring materials, mechanisms, processes, and properties, the handbook also highlights the latest applications in the field and points to new developments on the horizon. Photochemistry and Photophysics of Polymer Materials is divided into seventeen chapters, including: Optical and luminescent properties and applications of metal complex-based polymers Photoinitiators for free radical polymerization reactions Photovoltaic polymer materials Photoimaging and lithographic processes in polymers Photostabilization of polymer materials Photodegradation processes in polymeric materials Each chapter, written by one or more leading experts and pioneers in the field, incorporates all the latest findings and developments as well as the authors' own personal insights and perspectives. References guide readers to the literature for further investigation of individual topics. Together, the contributions represent a series of major developments in the polymer world in which light and its energy have been put to valuable use. Not only does this reference capture our current state of knowledge, but it also provides the foundation for new research and the development of new materials and new applications.

Offers coverage of all known commodity, transitional, engineering, high-temperature and high-

performance thermoplastics, and analyzes emerging developments in the creation of new thermoplastics. The text examines: important issues in the field for each substance discussed, including history, development and commercialization; polymer formation mechanisms and process technologies; the affect of structural and phase characteristics on properties; the commercial relevance of thermoplastic blends, alloys, copolymers and composites; and more.
Additive manufacturing (AM) methods have grown and evolved rapidly in recent years. AM for polymers is an exciting field and has great potential in transformative and translational research in many fields, such as biomedical, aerospace, and even electronics. Current methods for polymer AM include material extrusion, material jetting, vat polymerisation, and powder bed fusion. With the promise of more applications, detailed understanding of AM—from the processability of the feedstock to the relationship between the process–structure–properties of AM parts—has become more critical. More research work is needed in material development to widen the choice of materials for polymer additive manufacturing. Modelling and simulations of the process will allow the prediction of microstructures and mechanical properties of the fabricated parts while complementing the understanding of the physical phenomena that occurs during the AM processes. In this book, state-of-the-art reviews and current research are collated, which focus on the process–structure–properties relationships in polymer additive manufacturing.
Abstract: PET is a thermoplastic polymer that is extensively used in the production of packaging material for applications such as drawn fibers, bottles, and stretched films. Its industrial applicability is largely based on the fact that it undergoes strain induced crystallization on deformation just above its glass transition temperature Tg. Crystallization

imparts increased density, stiffness, dimensional stability, and resistance to permeability. However, the crystallization process and the mechanical behavior of PET above its Tg is highly dependent on factors such as temperature, strain rate, and the mode of deformation. This makes it necessary to have a reliable material model that can be used in FEM simulations to predict its mechanical behavior. This thesis is aimed at achieving two goals: i) to mechanically characterize three PET-PCT blends that have not been previously tested (PET00, PET1.5, and PET12) and to do a comparative study of the five PET-PCT blends. This was done by testing five PET-PCT blends over a range of temperatures and strain rates in uniaxial compression and plane strain compression modes. ii) to modify the Dupaix-Krishnan constitutive model to predict the occurrence and effects of strain induced crystallization in PET. This involved testing PET and PETG under load-hold conditions to identify the criteria that induce crystallization in PET. Subsequently the material model was modified by incorporating these criteria. Monotonic tests were conducted for the five PET-PCT blends (PET00, PET1.5, PET3.5, PET12, and PETG) at temperatures of 90C and 100C and strain rates of 0.1/s, 0.05/s, and 0.005/s in uniaxial compression and plane strain compression. The experimental results were then fit to the Dupaix-Boyce constitutive model for these five blends. The model was able to successfully capture the dependence of the material behavior on temperature, strain rate, and strain state above Tg for the five materials. The experimental results were also useful in making a comparison of the mechanical behavior of the five materials to each other. This showed that the behavior of the low PCT content materials were different from that of the high PCT content materials at conditions that favored crystallization. Load hold experiments were conducted on PET00, PET3.5 and PETG at temperatures of 90C and 100C, and strain rates of 0.1/s and

0.005/s in both uniaxial and plane strain compression. The results obtained were similar to that of the monotonic tests, as they showed that while PET00 and PET3.5 crystallized at certain favorable conditions, PETG did not. Therefore, it was found that the load hold condition was not one of the factors that lead to crystallization. Crystallization occurred in PET only when all of the following conditions were met: i) high strain rates of 0.1/s and above, ii) temperatures of 90C-100C, iii) plane strain compression and iv) after a certain amount of deformation. Based on these findings, changes were made to the Dupaix- Krishnan material model to improve its ability to predict the occurrence and effects of strain-induced crystallization on the large strain deformation behavior of PET near Tg.

This guide gives an overview and insight into the advanced technology of thermoforming, discussing different processes and applications. It reveals the possibilities of thermoforming from forming, filling, and sealing processes, to using thermoforming technology for cost saving purposes and maximum efficiency. Its coverage addresses the simulation of formed parts as well as applications of technical parts and packaging. The reader is guided through the path of development, design, machine and mold technology and production, as well as the latest innovations, from thermoformed bottles to fully automated assembly lines.

High performance plastics are replacing traditional materials in hostile environments. They possess characteristics such as exceptional strength, lightweight, temperature resistance (usually in excess of 160°C), chemical resistance and dimensional stability. In addition, plastics are relatively easy to process and can be coloured (or transparent) and moulded to create innovative and attractive structures. The fun car market illustrates the increasing use of plastics materials and the versatility and appeal needed in materials for today's marketplace.

This two day international conference brought together experts discussing the latest developments in materials including properties, processing and applications.There are many different types of high performance elastomers. Their unique properties are essential in hostile environments and application areas include the petrochemical and refining industries, automotive, aerospace, defence, wire and cable, construction, chemical plants, nuclear, medical, food and seals. Correct material selection, compounding and processing are essential. These proceedings have brought together a collection of papers for material suppliers, engineers, compounders, manufacturers, processors and end-users of high performance elastomers who discussed the most appropriate materials and formulations for different applications.