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Neat and binary molecular glass formers are investigated by means of broadband dielectric spectroscopy with the aim of gaining a systematic understanding of the molecular slowing down, which is characteristic for the glass transition. By combining frequency and time domain techniques a dynamic range from 10^-6, Hz up to 10^9, Hz is covered. Particular attention is drawn to the fact that different types of secondary relaxations may appear during the process of supercooling. In certain simple glass formers such secondary processes are clearly of intermolecular origin, and it turns out that in mixtures of small and large molecules secondary relaxations can be systematically altered by changing the concentration of the constituents. Thus, the relation between different types of secondary processes may be clarified. It is typical of glass forming substances that the decay of orientational correlations is non-exponential, and, correspondingly, the dielectric loss spectra are broadened as compared to a simple Debye-like relaxation process. The latter effect is particularly pronounced in binary glass formers, and one aim of the present work is to provide and apply an appropriate tool for a line shape analysis of the relaxation spectra in both neat end binary systems. On the other hand, the nature of spectral broadening is investigated by means of non-resonant dielectric hole burning, which allows to distinguish between heterogeneous and homogeneous dynamics in a system. It turns out that in binary glass formers dynamic heterogeneities are particularly pronounced and that the effects of dielectric hole burning in both neat and binary systems are very well described within the framework of a model of selective local heating.
experimental and theoretical dielectric studies of the structure and dynamics of complex systems. Complex systems constitute an almost universal class of materials including associated liquids, polymers, biomolecules, colloids, porous materials, doped ferroelectric crystals, nanomaterials, etc. These systems are characterized by a new "mesoscopic" length scale, intermediate between molecular and macroscopic. The mesoscopic structures of complex systems typically arise from fluctuations or competing interactions and exhibit a rich variety of static and dynamic behaviour. This growing field is interdisciplinary; it complements solid state and statistical physics, and overlaps considerably with chemistry, chemical engineering, materials science, and biology. A common theme in complex systems is that while such materials are disordered on the molecular scale and homogeneous on the macroscopic scale, they usually possess a certain degree of order on an intermediate, or mesoscopic, scale due to the delicate balance of interaction and thermal effects. In the present Volume it is shown how the dielectric spectroscopy studies of complex systems can be applied to determine both their structures and dynamics.

Nonlinear Dielectric Spectroscopy-Ranko Richert
2018-06-18 This book introduces the ideas and concepts of nonlinear dielectric spectroscopy, outlines its history, and provides insight into the present state of the art of the experimental technology and understanding of nonlinear dielectric effects. Emphasis is on what can be learned from nonlinear experiments that could not be derived from the linear counterparts. The book explains that nonlinear dielectric spectroscopy can be used as a tool to measure structural recovery or physical aging, as well as connections between dynamics and thermodynamic variables such as enthalpy and entropy. Supercooled liquids in their viscous regime are ideal candidates for
investigating nonlinear effects, because they are particularly sensitive to changes in temperature, and thus also to changes in the electric field. Other interesting materials covered are plastic crystals and complex liquids near criticality. The book also points out that, compared with other techniques such as mechanical shear experiments, the nonlinear regime of dielectric spectroscopy is special in the sense that the energies involved always remain small compared with thermal energies. To demonstrate this, nonlinear features of mechanical experiments are discussed. Theoretical approaches to nonlinear effects are particularly complicated because the tools available for the linear regime no longer apply. As a result, there is no single generally accepted theory to nonlinear dielectric responses of real liquids. Various approaches to nonlinear dielectric features have been reported, and the different aspects are communicated in several chapters. The book communicates recent progress most effectively through individual contributions from specialists in their respective fields.

Chapter 'Third and Fifth Harmonic Responses in Viscous Liquids' is available open access under a Creative Commons Attribution 4.0 International License via link.springer.com.

**Crystallization as Studied by Broadband Dielectric Spectroscopy** - Tiberio A. Ezquerra 2020-10-28

This book presents new approaches that offer a better characterization of the interrelationship between crystalline and amorphous phases. In recent years, the use of dielectric spectroscopy has significantly improved our understanding of crystallization. The combination of modern scattering methods, using either synchrotron light or neutrons and infrared spectroscopy with dielectrics, is now helping to reveal modifications of both crystalline and amorphous phases. In turn, this yields insights into the underlying...
physics of the crystallization process in various materials, e.g. polymers, liquid crystals and diverse liquids. The book offers an excellent introduction to a valuable application of dielectric spectroscopy, and a helpful guide for every scientist who wants to study crystallization processes by means of dielectric spectroscopy.

**Nuclear Magnetic Resonance**  2015-05-12
Applications of nuclear magnetic resonance span a wide range of scientific disciplines, from physics to medicine. This series has provided an essential digest of the NMR literature for more than four decades and each volume provides unrivalled coverage of the literature on this topic. Continuous coverage on some topics such as theoretical and physical aspects of nuclear shielding is balanced by the desire for coverage on newer topics like applications in biological systems and materials science. For those wanting to become rapidly acquainted with NMR or seasoned practitioners, this is an invaluable source of current methods and applications.

**Materials for Biomedical Engineering: Thermoset and Thermoplastic Polymers**  Valentina Grumezescu 2019-03-21
Materials for Biomedical Engineering: Thermoset and Thermoplastic Polymers presents the newest and most interesting approaches to intelligent polymer engineering in both current and future progress in biomedical sciences. Particular emphasis is placed on the properties needed for each selected polymer and how to increase their biomedical potential in varying applications, such as drug delivery and tissue engineering. These materials are intended for use in diagnoses, therapy and prophylaxis, but are also relatable to other biomedical related applications, such as sensors. Recent developments and future perspectives regarding their use in biomedicine are discussed in detail, making this book an ideal source on the topic.
Highlights the most well-known applications of thermoset and thermoplastic polymers in biological and biomedical engineering. Presents novel opportunities and ideas for developing or improving technologies in materials for companies, those in biomedical industries, and others. Features at least 50% of references from the last 2-3 years.

Fractals, Diffusion, and Relaxation in Disordered Complex Systems-Yuri P. Kalmykov 2006-07-21
Fractals, Diffusion and Relaxation in Disordered Complex Systems is a special guest-edited, two-part volume of Advances in Chemical Physics that continues to report recent advances with significant, up-to-date chapters by internationally recognized researchers.

Dielectric Properties of Ionic Liquids-Marian Paluch 2016-08-01
This book discusses the mechanisms of electric conductivity in various ionic liquid systems (protic, aprotic as well as polymerized ionic liquids). It hence covers the electric properties of ionic liquids and their macromolecular counterpanes, some of the most promising materials for the development of safe electrolytes in modern electrochemical energy devices such as batteries, super-capacitors, fuel cells and dye-sensitized solar cells. Chapter contributions by the experts in the field discuss important findings obtained using broadband dielectric spectroscopy (BDS) and other complementary techniques. The book is an excellent introduction for readers who are new to the field of dielectric properties of ionic conductors, and a helpful guide for every scientist who wants to investigate the interplay between molecular structure and dynamics in ionic conductors by means of dielectric spectroscopy.

Broadband Dielectric Spectroscopy-Friedrich Kremer 2012-12-06
Both an introductory course to broadband dielectric
spectroscopy and a monograph describing recent dielectric contributions to current topics, this book is the first to cover the topic and has been hotly awaited by the scientific community.

Metastable Systems under Pressure—Sylwester Rzoska 2009-11-19 recently discovered advantages of amorphous forms of medicines/pharmaceutical products which focused a significant part of industry-related efforts on the GFA (Glass Forming Ability) and the glass temperature (T) versus pressure (P) dependences.

\[ T(P) = F(P)D(P) = T_0 + \exp\left(\frac{g}{T_0}P\right) \]

\[ D(P) = \frac{T_0}{T_0 + P} \]

The parameterization of experimental data via the novel, modified Glat Sizm elon type equation, given in the Figure.

Polymer/POSS Nanocomposites and Hybrid Materials—Susheel Kalia 2018-11-27 This book provides an overview of polymer nanocomposites and hybrid materials with polyhedral oligomeric silsesquioxanes (POSS). Among inorganic nanoparticles, functionalized POSS are unique nano-building blocks that can be used to create a wide variety of hybrid and composite materials, where precise control of nanostructures and properties is required. This book describes the influence of incorporation of POSS moieties into (organic) polymer matrices on the mechanical, thermal and flammability behavior of composites and hybrid organic-inorganic materials. Importantly, POSS-containing materials can be bio-functionalized by linking e.g. peptides and growth factors.
through appropriate surface modification in order to enhance the haemo-compatibility of cardiovascular devices made of these materials. This volume includes descriptions of synthesis routes of POSS and POSS-containing polymeric materials (e.g. based on polyolefines, epoxy resins and polyurethanes), presentation of POSS’ role as flame retardants and as biocompatible linker, as well as the depiction of decomposition and ageing processes.

**Ionic Liquids further UnCOILed**

Natalia V. Plechkova 2014-03-05 Critical overviews from the front line of ionic liquids research Ionic Liquids Further UnCOILed: Critical Expert Overviews continues the discussion of new processes and developments in ionic liquid technology introduced in the first volume. Written by an international group of key academic and industrial chemists, this next book in the series includes eleven overviews of specific areas of ionic liquid chemistry including: Physicochemical properties of ionic liquids A patent survey Ionic liquid membrane technology Engineering simulations Molecular simulations The goal of this volume is to provide expert overviews that range from applied to theoretical, synthetic to analytical, and biotechnological to electrochemical, while also offering consistent abbreviations of ionic liquids throughout the text. The value of Ionic Liquids Further UnCOILed: Critical Expert Overviews lies in the authors’ expertise and their willingness to share it with the reader. Included in the book is insight into typical problems related to experimental techniques, selection of liquids, and variability of data—all of which were overseen by Professor Ken Seddon, one of the book’s editors and a world leader in ionic liquids. This book is a must read for R&D chemists in industrial, governmental, and academic laboratories, and for commercial developers of environmentally sustainable...
processes. It offers insight and appreciation for the direction in which the field is going, while also highlighting the best published works available, making it equally valuable to new and experienced chemists alike.

**Theoretical and Spectroscopic Investigations on Ionogels**

Safna Hussan KP 2019-09-24

Today, an enormous amount of research is devoted to immobilizing ionic liquid (IL) for electrochemical applications, due to its potential as an excellent substitute for liquid electrolytes. Among the more well-known strategies, entrapping IL in the polymer matrix can be considered as a feasible, low cost method for large scale production of ionogel. The versatility of both IL and polymer chemistry allows us to develop an infinite number of ionogels. This book provides a complete overview of this subject, moving from the development of ionogel to its application. It covers characterization techniques in quantum mechanical calculations, structural and morphological studies, thermal behavior, molecular dynamics, and transport properties.

**Acting Principles of Nano-Scaled Matrix Additives for Composite Structures**

Michael Sinapius 2021-05-22

The book explores the effect of nanoscale matrix additives along the four levels of material formation, particle-resin interaction, the influence of nanoparticles on the processability of the polymer, the influence of nanoparticles on polymer curing and the influence of nanoparticles on the fiber plastic composite. Fiber-reinforced plastics have a significantly higher lightweight construction potential in components with a primary single- or biaxial stress state compared to isotropic metals. At the same time, their insensitivity to corrosion and their advantageous fatigue properties can help to reduce maintenance costs. Due to their outstanding specific mechanical properties, they
are among today's high-performance lightweight construction materials. These properties make them particularly attractive in the field of mobility. However, as soon as the matrix properties dominate the mechanical properties, e.g. in the case of fibre-parallel compressive strength, significant weaknesses become apparent in the mechanical properties. Here, one approach is to significantly increase the matrix properties through nanoscale ceramic additives and at the same time to guarantee the processability of the resin.

Relaxation and Diffusion in Complex Systems-K.L. Ngai 2011-03-25 The usefulness of the book to the reader is exposure to many different classes of materials and relaxation phenomena. They are tied together by the universal relaxation and diffusion properties they share, and a consistent explanation of their origin. The readers can apply what they learn to solve their own problems and use it as a stepping-stone to make further advances in theoretical understanding of the origin of the universality.

Biological Water-Gertz I. Likhtenshtein

Rational Design of Nanostructured Polymer Electrolytes and Solid-Liquid Interphases for Lithium Batteries-Snehashis Choudhury 2019-09-25 This thesis makes significant advances in the design of electrolytes and interfaces in electrochemical cells that utilize reactive metals as anodes. Such cells are of contemporary interest because they offer substantially higher charge storage capacity than state-of-the-art lithium-ion battery technology. Batteries based on metallic anodes are currently considered impractical and unsafe because recharge of the anode causes physical and chemical instabilities that produce dendritic deposition of the metal leading to catastrophic failure via thermal runaway. This thesis
utilizes a combination of chemical synthesis, physical & electrochemical analysis, and materials theory to investigate structure, ion transport properties, and electrochemical behaviors of hybrid electrolytes and interfacial phases designed to prevent such instabilities. In particular, it demonstrates that relatively low-modulus electrolytes composed of cross-linked networks of polymer-grafted nanoparticles stabilize electrodeposition of reactive metals by multiple processes, including screening electrode electrolyte interactions at electrochemical interfaces and by regulating ion transport in tortuous nanopores. This discovery is significant because it overturns a longstanding perception in the field of nanoparticle-polymer hybrid electrolytes that only solid electrolytes with mechanical modulus higher than that of the metal electrode are able to stabilize electrodeposition of reactive metals.

**Carbon Nanomaterials Sourcebook**-Klaus D. Sattler

2018-09-03 The Carbon Nanomaterials Sourcebook contains extensive, interdisciplinary coverage of carbon nanomaterials, encompassing the full scope of the field—from physics, chemistry, and materials science to molecular biology, engineering, and medicine—in two comprehensive volumes. Written in a tutorial style, this second volume of the sourcebook: Focuses on nanoparticles, nanocapsules, nanofibers, nanoporous structures, and nanocomposites Describes the fundamental properties, growth mechanisms, and processing of each nanomaterial discussed Explores functionalization for electronic, energy, biomedical, and environmental applications Showcases materials with exceptional properties, synthesis methods, large-scale production techniques, and application prospects Provides the tools necessary for understanding current and future technology developments, including important equations, tables, and graphs Each chapter is dedicated to a different type
of carbon nanomaterial and addresses three main areas: formation, properties, and applications. This setup allows for quick and easy search, making the Carbon Nanomaterials Sourcebook: Nanoparticles, Nanocapsules, Nanofibers, Nanoporous Structures, and Nanocomposites a must-have reference for scientists and engineers.

**Dielectric Spectroscopy of Polymeric Materials** - James Patrick Runt 1997 Beginning with a complete discussion of the fundamentals of dielectric spectroscopy, this book examines in detail the methods used in data modeling and in such specialized techniques as high-frequency dielectric measurements and thermally stimulated currents. The book covers applications in a range of polymeric systems including solutions, blends, and liquid crystals.

**Proton Transport in Imidazoles** - 2015 The impact of supramolecular hydrogen bonded networks on dynamics and charge transport in 2-ethyl-4-methylimidazole (2E4MIm), a model proton-conducting system, is investigated by broadband dielectric spectroscopy, depolarized dynamic light scattering, viscometry, and calorimetry. It is observed that the slow, Debye-like relaxation reflecting the supramolecular structure in neat 2E4MIm is eliminated upon the addition of minute amounts of levulinic acid. This is attributed to the dissociation of imidazole molecules and the breaking down of hydrogen-bonded chains, which leads to a 10-fold enhancement of ionic conductivity.

**Ionic Liquid-Based Surfactant Science** - Bidyut K. Paul 2015-09-21 This volume will be summarized on the basis of the topics of Ionic Liquids in the form of chapters and sections. It would be emphasized on the synthesis of ILs of different types, and stabilization of amphiphilic self-assemblies in conventional and newly developed ILs to reveal
formulation, physicochemical properties, microstructures, internal dynamics, thermodynamics as well as new possible applications. It covers: Topics of ionic liquid assisted micelles and microemulsions in relation to their fundamental characteristics and theories Development bio-ionic liquids or greener, environment-friendly solvents, and manifold interesting and promising applications of ionic liquid based micelles and micromulsions

**Progress in Rubber Nanocomposites**-Sabu Thomas 2016-10-27 Progress in Rubber Nanocomposites provides an up-to-date review on the latest advances and developments in the field of rubber nanocomposites. It is intended to serve as a one-stop reference resource to showcase important research accomplishments in the area of rubber nanocomposites, with particular emphasis on the use of nanofillers. Chapters discuss major progress in the field and provide scope for further developments that will have an impact in the industrial research area. Global leaders and researchers from industry, academia, government, and private research institutions contribute valuable information. A one-stop reference relating to the processing and characterization of rubber nanocomposites Presents the morphological, thermal, and mechanical properties that are discussed in detail Contains key highlights in the form of dedicated chapters on interphase characterization, applications, and computer simulation

**Handbook of Condensation Thermoplastic Elastomers**-Stoyko Fakirov 2006-05-12 Reporting on the work of an international team of scientists actively involved in the study of thermoplastic elastomers (TPE) based on polyesters, polyamides, and polyurethanes, this book is the first to provide a detailed description of condensation TPE with close attention paid to polyamide-based systems. Reflecting the increasing importance of TPE as
engineering plastics, the authors discuss the widened application opportunities by preparing systems with various chemical compositions and molecular structures as (semi-) interpenetrating networks. The contents also cover the chemical aspects, physical structure and properties, life cycle assessment, and recycling possibilities as well as such unique "smart" properties like the shape memory effect of the three classes of thermoplastic elastomers.

**Engineered Materials Abstracts- 1993-04**

**SPE/ANTEC 1999 Proceedings**-Spe 1999-04-29 Volume 2 of the conference proceedings of the SPE/Antac on 'Plastics Bridging the Millennia- subtopic of 'Materials', held on the 2-6 May 1999 in New York City, USA.

**New Polymeric Materials-**
Ljiljana S. Korugic-Karasz 2005 The book consists of contributions from friends and associates of Professor Frank E. Karasz at a Symposium held in honor of his 70th birthday. The general theme is New Polymeric Materials and the book is organized into several sub-topics including, New Opto-electronic Polymers, New Bio Medical Polymers, New Polymers in Nano-technology, and New Instrumental Technologies for Polymer Characterization. The book is unique in bringing together leaders in the field active in the latest developments of new polymers for advanced technological applications. In addition Professor Karasz is one of the true giants in the field of opto-electronic polymers used as Light Emitting Diodes (LED's) and is one of the principal architects in providing the current understanding of the thermodynamic principles of polymer blending. A volume celebrating Professor Karasz's achievements would have wide appeal to the international community.

**Ionic Liquids-**Natalia Plechkova 2009 This book
reflected recent developments in the rapidly-expanding field of ionic liquids, and looks ahead to its future. An exploration of new properties of ionic liquids, and their use in biochemistry, medicine, and nanochemistry, is included.

**Effect of Meta-carborane on Segmental Dynamics in a Bimodal Poly(dimethylsiloxane) Network** - 2008 Bimodal networks of polydimethylsiloxane (PDMS) filled with varying amounts of icosahedral meta-carborane (m-CB) have been developed and characterized by broadband dielectric spectroscopy (BDS) and static 1H Multiple Quantum Nuclear Magnetic Resonance (MQ NMR). Both BDS and MQ NMR showed evidence for a decrease in the polymer chain dynamics. BDS spectra quantified a normal-mode relaxation near 40 Hz at 40 C. The frequency maximum observed for filled samples decreased with increasing m-CB content until contents greater than 5 wt. %. The width of the relaxation spectrum increased with the addition of small quantities of filler and decreased with filler contents greater than 5 wt. %. Agglomeration effects were observed at loadings greater than 5 wt % as manifest by the onset of low frequency Maxwell-Wagner-Sillars (MWS) processes. The MQ NMR data allowed the characterization of distributions of the residual dipolar couplings, \([Omega]_{d}\) and thus in the dynamic order parameter, Sb, consistent with the bimodal network architecture expected from the synthesis protocol used. Upon addition of less than 10 wt.% m-CB filler, the mean \([Omega]_{d}\) for the longer chains increased by 46% and the width of the distribution increased by 33%. The mean \([Omega]_{d}\) for the shorter chains increased by much less, indicative of preferential dispersion of the filler particles in the long chain domains of the network structure. We conclude that the mechanism of reinforcement is likely a free volume space filling at low loadings transitioning to...
complex molecular filler and polymer chain interaction phenomena at higher loadings.

The Scaling of Relaxation Processes - Friedrich Kremer
2018-07-20 The dielectric properties especially of glassy materials are nowadays explored at widely varying temperatures and pressures without any gap in the spectral range from μHz up to the Infrared, thus covering typically 20 decades or more. This extraordinary span enables to trace the scaling and the mutual interactions of relaxation processes in detail, e.g. the dynamic glass transition and secondary relaxations, but as well far infrared vibrations, like the Boson peak. Additionally the evolution of intra-molecular interactions in the course of the dynamic glass transition is also well explored by (Fourier Transform) Infrared Spectroscopy. This volume within 'Advances in Dielectrics' summarizes this knowledge and discusses it with respect to the existing and often competing theoretical concepts.

Nuclear Magnetic Resonance - G A Webb
2007-10-31 As a spectroscopic method, Nuclear Magnetic Resonance (NMR) has seen spectacular growth over the past two decades, both as a technique and in its applications. Today the applications of NMR span a wide range of scientific disciplines, from physics to biology to medicine. Each volume of Nuclear Magnetic Resonance comprises a combination of annual and biennial reports which together provide comprehensive of the literature on this topic. This Specialist Periodical Report reflects the growing volume of published work involving NMR techniques and applications, in particular NMR of natural macromolecules which is covered in two reports: "NMR of Proteins and Acids" and "NMR of Carbohydrates, Lipids and Membranes". For those wanting to become rapidly acquainted with specific areas of NMR, this title provides unrivalled scope of coverage. Seasoned
practitioners of NMR will find this an invaluable source of current methods and applications. Specialist Periodical Reports provide systematic and detailed review coverage in major areas of chemical research. Compiled by teams of leading authorities in the relevant subject areas, the series creates a unique service for the active research chemist, with regular, in-depth accounts of progress in particular fields of chemistry. Subject coverage within different volumes of a given title is similar and publication is on an annual or biennial basis.

**Synthetic Metals**- 1998

**Australian Journal of Chemistry**- 2007

**Spatial and Spectral Mode Mapping of a Dielectric Nanodot by Broadband Interferometric Homodyne Scanning Near-field Spectroscopy**- Jinxin Zhan 2020

**Polymer Journal**- 2002

**Deutsche Nationalbibliographie und Bibliographie der im Ausland erschienenen deutschsprachigen Veröffentlichungen**- 2007

**Structural Glasses and Supercooled Liquids**- Peter G. Wolynes 2012-04-10 With contributions from 24 global experts in diverse fields, and edited by world-recognized leaders in physical chemistry, chemical physics and biophysics, Structural Glasses and Supercooled Liquids: Theory, Experiment, and Applications presents a modern, complete survey of glassy phenomena in many systems based on firmly established characteristics of the underlying molecular motions as deduced by first principle theoretical calculations, or with direct/single-molecule experimental techniques. A well-rounded view of a variety of disordered systems where
Impacts of Impurities and Thermal History on the Electrical Conduction and Charge Trapping Characteristics in Crosslinked Polyethylene Thin Films - Roger Craig Walker 2020

The work presented in this dissertation is primarily aimed at improving the understanding of the electrical properties of the insulating polymer crosslinked polyethylene (XLPE) in order to support its use as power cable insulation. XLPE has been used for decades as the material of choice in this application due to its low cost, the ease of maintaining it, its improved environmental friendliness over what it was replacing, and -- most importantly -- its low DC conductivity and AC losses. However, it has several unaddressed issues associated with its use in the long term due to extrinsic impurities (such as water and acetophenone) and intrinsic variability (due to its semicrystalline nature). A better understanding of how these factors influence the electrical properties of XLPE is needed both to enhance the fundamental knowledge regarding this prominent polymer and to improve its utility as power cable insulation. As such, an analysis of the electrical properties of XLPE was carried out by using four separate types of analyses. Broadband dielectric spectroscopy (BDS) was used to analyze the AC response. Conduction current measurement (CCM) and current-voltage measurement (IVM) were used to analyze the DC response. Thermally cooperative phenomena, which are epitomized by supercooled liquids, take place is provided. These systems include structural glasses and supercooled liquids, polymers, complex liquids, protein conformational dynamics, and strongly interacting electron systems with quenched/self-generated disorder. Detailed calculations and reasoned arguments closely corresponding with experimental data are included, making the book accessible to an educated non-expert reader.
stimulated depolarization current (TSDC) technique was used to analyze the charge trapping characteristics of polyethylene. XLPE thin film samples were generated by melt pressing pellets of low-density polyethylene (LDPE) that were infused with the crosslinking agent dicumyl peroxide (DCP). Some LDPE pellets were not infused with DCP and used to make LDPE thin films for comparative purposes. After fabrication, a selection of films was degassed in order to remove impurities. Some of those films were then soaked in specific impurities to intentionally re-introduce that one in particular. Aluminum electrodes were then applied to the samples in the same high-vacuum evaporation chamber to a thickness of 50 nm at a deposition rate of 2.5 A/s. Electrode diameters were fixed at either 1 cm or 3 cm, and the thickness was measured after electrode deposition. Chapter 3 goes into the details of the AC analysis of polyethylene. Samples were characterized electrically by their dielectric loss, a measure of inefficiency during the AC cycle that can also be related to the AC conductivity. It was found that the presence of impurities such as DCP byproducts had a strong impact on the AC response in two different ways. One is that the presence of impurities above a certain threshold led to significant increases in the dielectric loss at room temperature. The other is that excess impurities modified the structure as was seen by alterations in the temperature coefficient of capacitance (TCC). The impurities are polar in nature and created an internal pressure that enhanced thermal expansion when compared to degassed XLPE and to as-received LDPE. Chapter 4 goes into the details of the phenomenon of electrical compensation in polyethylene. Compensation is an observed trend where the activation energy and pre-exponential factor for conductivity are correlated. It had been previously observed in the DC conduction of LDPE and it was found that it can also be observed in the DC conduction of XLPE via CCM. Additionally, it was also found in AC conduction as observed in the BDS results. Electrical
compensation was not observed in as-received XLPE samples that were water soaked instead of degassed for AC conduction, and those samples generally had low activation energy of 0.2 eV or less. All other samples exhibited variation in the range of 0.2 eV to 1.4 eV in AC. All samples showed compensation in DC in the range of 0.2 eV to 1.0 eV for activation energies. The observed compensation was determined to arise from sample to sample variation in polar impurities such as water and was sensitive to the thermal history of each sample. Chapter 5 goes into the details of charge trapping in polyethylene as examined using the TSDC technique. TSDC analysis results in a spectrum of current measured as the temperature rises, indicating what temperatures were needed to release trapped charges as well as the amount of stored charge and the energy associated with that release. As-received XLPE samples tended to exhibit one peak in the TSDC spectra associated with impurities. Their removal via degassing meant that three peaks could be observed -- that same impurity peak, but also peaks associated with molecular motions near the glass transition temperature and with charge injection in the melting range of polyethylene. Harsher degassing was shown to reduce the impacts of these impurities and of charge injection. Acetophenone was found to be the key DCP byproduct in determining the overall trapping characteristics of XLPE. Chapter 6 goes into the details of a brief examination of the response of XLPE to applied DC bias using IVM. Both the time response of the current and the current-voltage spectra were examined. It was found that overall response of XLPE could be altered depending on one of two things: the thermal history via changing the degassing temperature and the presence of impurities via the addition of acetophenone. Both the standard 65°C degassed and the test 90°C degassed samples exhibited true conduction current with the 90°C samples having reduced conductivity and higher activation energy in
comparison. The addition of ACP into the standard degassed samples reduced the activation energy and the conductivity but the current response was now due to polarization rather than true conduction. Additionally, standard samples were found to exhibit space charge limited current while the others had ohmic or sub-ohmic response. Chapter 7 contains a summary and directions for future work. In general, it is suggested that future investigations should combine experiment and simulation to best determine how thermal history and impurities determine the electrical properties of XLPE samples. What is needed to know is how precisely these two factors alter the resulting structure of the XLPE and contribute to changes in these various responses to applied electrical fields. It was also suggested to look into the impacts of other impurities not related to DCP such as antioxidants and nanoparticles.

Spectroscopy of Polymer Nanocomposites-Sabu

Thomas 2016-02-08
Spectroscopy of Polymer Nanocomposites explores the growing interest for a complete understanding of surfaces, hidden interfaces and nano, meso, and micro scale dispersion of filler particles in polymers which play an important role in their characterization. To date, there is no book that covers, in a concise manner, all techniques related to material characterization of polymer based nanocomposites. This book fills that gap and serves the growing interest by covering all aspects of the spectroscopic characterization of polymer nanocomposites. More than 25 spectroscopy characterization techniques, almost all used in materials science, are treated in the book, highlighting their potentialities and limitations. By comparing and presenting techniques and their specific application areas, the book provides scientists and engineers the information they need to solve specific problems and choose the right technique for analyzing the material structure. The techniques and structure-
property relations covered in the book include phase segregation of filler particles, filler agglomeration, filler dispersion, filler/polymer interactions, and interface/interphases of polymer nanocomposites in different length scales. Provides a comprehensive coverage of spectroscopy techniques for analyzing polymer nanocomposites Enables researchers and engineers to choose the right technique and make better materials decisions in research and a range of industries Presents the fundamentals, information on structure-property relations, and all other aspects relevant for understanding spectroscopic analyses of nanoreinforced polymers and their applications

**Solution-Processable Components for Organic Electronic Devices** by Beata Luszczynska

Provides first-hand insights into advanced fabrication techniques for solution processable organic electronics materials and devices

The field of printable organic electronics has emerged as a technology which plays a major role in materials science research and development. Printable organic electronics soon compete with, and for specific applications can even outpace, conventional semiconductor devices in terms of performance, cost, and versatility. Printing techniques allow for large-scale fabrication of organic electronic components and functional devices for use as wearable electronics, healthcare sensors, Internet of Things, monitoring of environment pollution and many others, yet-to-be-conceived applications. The first part of Solution-Processable Components for Organic Electronic Devices covers the synthesis of: soluble conjugated polymers; solution-processable nanoparticles of inorganic semiconductors; high-k nanoparticles by means of controlled radical polymerization; advanced blending techniques yielding novel materials with extraordinary properties. The book also discusses
photogeneration of charge carriers in nanostructured bulk heterojunctions and charge carrier transport in multicomponent materials such as composites and nanocomposites as well as photovoltaic devices modelling. The second part of the book is devoted to organic electronic devices, such as field effect transistors, light emitting diodes, photovoltaics, photodiodes and electronic memory devices which can be produced by solution-based methods, including printing and roll-to-roll manufacturing. The book provides in-depth knowledge for experienced researchers and for those entering the field. It comprises 12 chapters focused on: ? novel organic electronics components synthesis and solution-based processing techniques ? advanced analysis of mechanisms governing charge carrier generation and transport in organic semiconductors and devices ? fabrication techniques and characterization methods of organic electronic devices Providing coverage of the state of the art of organic electronics, Solution-Processable Components for Organic Electronic Devices is an excellent book for materials scientists, applied physicists, engineering scientists, and those working in the electronics industry.

**Anelastic and Dielectric Effects in Polymeric Solids**

N. G. McCrum 1967