Oxygen And Water Barrier Properties Of Coated Whey Protein

Food packaging materials have traditionally been chosen to avoid unwanted interactions with the food. During the past two decades a wide variety of packaging materials have been devised or developed to interact with the food. These packaging materials, which are designed to perform some desired role other than to provide an inert barrier to outside influences, are termed 'active packaging'. The benefits of active packaging are based on both chemical and physical effects. Active packaging concepts have often been presented to the food industry with few supporting results of background research. This manner of introduction has led to substantial uncertainty by potential users because claims have sometimes been based on extrapolation from what little proven information is available. The forms of active packaging have been chosen to respond to various food properties which are often unrelated to one another. For instance many packaging requirements for post harvest horticultural produce are quite different from those for most processed foods. The object of this book is to introduce and consolidate information upon which active packaging concepts are based. Scientists, technologists, students and regulators will find here the basis of those active packaging materials, which are either commercial or proposed. The book should assist the inquirer to understand how other concepts might be applied or where they should be rejected.

This presentation describes various aspects of the regulation of tissue oxygenation, including the roles of the circulatory system, respiratory system, and blood, the carrier of oxygen within these components of the cardiorespiratory system. The respiratory system takes oxygen from the atmosphere and transports it by diffusion from the air in the alveoli to the blood flowing through the pulmonary capillaries. The cardiovascular system then moves the oxygenated blood from the heart to the microcirculation of the various organs by convection, where oxygen is released from hemoglobin in the red blood cells and moves to the parenchymal cells of each tissue by diffusion. Oxygen that has diffused into cells is then utilized in the mitochondria to produce adenosine triphosphate (ATP), the energy currency of all cells. The mitochondria are able to produce ATP until the oxygen tension or PO2 on the cell surface falls to a critical level of about 4 – 5 mm Hg. Thus, in order to meet the energetic needs of cells, it is important to maintain a continuous supply of oxygen to the mitochondria at or above the critical PO2 . In order to accomplish this desired outcome, the cardiorespiratory system, including the blood, must be capable of regulation to ensure survival of all tissues under a wide range of circumstances. The purpose of this presentation is to provide basic information about the operation and regulation of the cardiovascular and respiratory systems, as well as the properties of the blood and parenchymal cells, so that a fundamental understanding of the regulation of tissue oxygenation is achieved.

Food Packaging: Nanotechnology in the Agri-Food Industry, Volume 7, focuses on the development of novel nanobiomaterials, the enhancement of barrier performance of non-degradable and biodegradable plastics, and their fabrication and application in food packaging. The book brings together fundamental information and the most recent advances in the synthesis, design, and impact of alternative food packaging. Special attention is offered on smart materials and nanodevices that are able to detect quality parameters in packaged food, such as freshness, degradation, and contamination, etc. In addition, ecological approaches aiming to obtain bioplastics packages from waste materials are highlighted and discussed as a novel approach in modern food packaging. Nonetheless, this volume presents the advances made in biodegradable and bioactive packaging utilized for preserving flavor, nutritious ingredients, and therapeutic food compounds. Includes fabrication techniques, such as nanofiber films, nanocoating, nanocompositing, multi-layered structures, and layer-by-layer nanoassemblies based on synthetic and bio-based polymers Presents the latest information on new biodegradeable materials using fabrication of new high barrier plastics to enhance research Provides examples of risk assessment for nanomaterials for food safety and the benefits of antimicrobial food packaging

Plastic Films in Food Packaging

Biaxial Stretching of Film

Development of Active Packaging for Retort Food

Food Packaging and Preservation

Testing & Quality Assurance

The findings from the present study will be useful to select a suitable packaging films for pasteurization processes. It will also help to measure oxygen diffusion in food to describe microbial growth and oxidation processes.

Growing environmental concerns related to the use of synthetic non-biodegradable polymers in the packaging industry have led to the need for new, especially bio-based, materials. Currently, petroleum-based synthetic polymers are widely used due to their relatively low cost and high performance. Biodegradable plastics and fibre-based materials have been proposed as a solution to the waste problems related to these synthetic polymers. Fibre-based packaging materials have many advantages over their non-biodegradable competitors, such as stiffness vs. weight ratio and recyclability. However, poor barrier properties and sensitivity to moisture are the main challenges restricting their use. Application of a thin coating layer is one way to overcome these problems and to improve the barrier properties of such materials. Atomic layer deposition (ALD) is a well suited technique for depositing thin inorganic coatings onto temperature-sensitive materials such as polymer-coated boards and papers and polymer films. In the present work, thin and highly uniform Al2O3 coatings were deposited at relatively low temperatures of 80, 100 and 130 °C onto various bio-based polymeric materials employing the ALD technique. The study demonstrates that a 25-nm-thick ALD-grown Al2O3 coating significantly enhances the oxygen and water vapour barrier performance of these materials. Promising barrier

properties were obtained with polylactide-coated board, hemicellulose-coated board as well as various biopolymer (polylactide, pectin and nanofibrillated cellulose) films after coating with a 25-nm-thick Al2O3 layer. Thin Al2O3 coatings can improve the properties of biopolymers, enabling the use of these renewable polymers in the production of high-performance materials for demanding food and pharmaceutical packaging applications. The future roll-toroll ALD technology for coating polymers with inorganic thin films will increase the industrial potential of these materials and could lead to further opportunities for their commercialization.

Permeability Properties of Plastics and Elastomers, 2nd Ed.A Guide to Packaging and Barrier MaterialsCambridge University Press

Building climate resilience for food security and nutrition

Crystalline Polymers in Multilayered Films and Blend Systems

The Wiley Encyclopedia of Packaging Technology

Materials, Technology and Applications

The State of Food Security and Nutrition in the World 2018

In-Package Thermal Pasteurization

The value of the groceries purchases in the USA is over $500 billion annually, most of which is accounted for by packaged foods. Plastic packaging of foods is not only ubiquitous in developed economies, but increasingly commonplace in the developing world, where plastic packaging is instrumental in decreasing the proportion of the food supply lost to spoilage. This new handbook is a combination of new material and updated chapters, chosen by Dr. Sina Ebnesajjad, from recently published books on this subject. Plastic Films in Food Packaging offers a practical handbook for engineers, scientists and managers working in the food packaging industry, providing a tailor-made package of science and engineering fundamentals, best practice techniques and guidance on new and emerging technologies. By covering materials, design, packaging processes, machinery and waste management together in one book, the authors enable the reader to take a lifecycle approach to food packaging. The Handbook addresses questions related to film grades, types of packages for different types of foods, packaging technologies, machinery and waste management. Additionally the book provides a review of new and emerging technologies. Two chapters cover the development of barrier films for food packaging and the regulatory and safety aspects of food packaging. Essential information and practical guidance for engineers and scientists working at all stages of the food packaging lifecycle: from design through manufacture to recycling Includes key published material on plastic films in food packaging, updated specifically for this Handbook, and new material on the regulatory framework and safety aspects Coverage of materials and applications together in one handbook enables engineers and scientists to make informed design and manufacturing decisions

"One of the major concerns with respect to metallized films is the effect of flexing on their barrier properties. Films encounter a series of mechanical stress situations during manufacturing, processing, handling, and distribution. These mechanical stresses often result in flexing of the packaging film, which is more prominent with metallized films. The first part of my study evaluates the effect of real stresses of flex by using packages already manufactured and that have been through the distribution cycle. Metallized film samples from these packages were tested to see the effect of real stress on their barrier properties. The results showed an increase in the oxygen transmission rates and water vapor transmission rates of the flexed samples indicating that flexing decreases the barrier properties of metallized films. Flexing leads to the initiation of pinholes that subsequently lead to a loss in barrier properties. The second part of my study evaluates whether the Gelbo flex tester simulates the actual distribution environment encountered by flexible packages. The metallized films were submitted to 10, 50, and 100 full flex cycles on a Gelbo flex tester and their permeation rates were evaluated comparatively. The results showed that for different films, different numbers of flex cycles are required to simulate mechanical stress during processing and distribution"--Abstract.

This extensively revised and updated second edition of the only data handbook available on the properties of commercial polymeric films details the permeability characteristics of over 125 major plastic and elastomer packaging materials. New to this edition are 92 resin chapters containing textual summary information including: category, general description, processing methods, applications, and general permeability considerations for water vapor, oxygen, and other gases including aroma and flavor. The product data is presented in graphical and tabular format, retaining the familiar format of the first edition and allowing easy comparison between materials and test conditions.

Permeability Properties of Plastics and Elastomers, 2nd Ed.

Food Packaging Materials

Organic Vapor Permeability of Transparent High Barrier Films Utilizing High Performance Thin Al2O3 Coating Layer

A Coated Film Having Excellent Oxygen and Water Vapor Barrier Properties, Lainability, and Clarity

Surface Sulfonation of Polymers to Impart Selected Barrier Properites

Polymeric Packaging Films for Thermal Pasteurization Processes

Poly(lactic acid) (PLA), a bio-based polymer, has several attractive properties such as excellent stiffness, reasonable strength, excellent flavor and aroma barrier, as well as good grease and oil resistance. Despite these attributes, PLA's applicability as a flexible food packaging material is limited due to several drawbacks such as brittleness, poor water vapor and moderate oxygen barrier properties as well as film processing difficulties due to its

insufficient melt strength. This study was aimed at overcoming these drawbacks to widen PLA's applicability in the food packaging industry.Firstly, the effectiveness and efficiency of two newly developed food grade multifunctional epoxies with low and high epoxy equivalent weights in chain extending/branching PLA were studied in a torque rheometer, in order to overcome the issue of PLA's insufficient melt strength. Both chain extender (CE) grades not only chain-extended PLA effectively as indicated by a significant increase in the mixing torque as well as PLA's melt viscosity and molecular weight, but also branched it leading to its reduced crystallinity. Infrared results indicated that chain extension occurred through the ring opening reaction of epoxy groups in the CE with PLA's hydroxyl and/or carboxyl groups. This chain extension/branching was beneficial in overcoming PLA film's brittleness since its impact strength increased almost linearly with the CE content.Secondly, cellulose nanocrystals (CNCs) were added to a PLA matrix to increase its crystallinity and act as impermeable regions in order to improve its barrier properties. However, CNCs were difficult to disperse in non-polar polymers due to their high polarity and strong hydrogen bonding forces. Therefore, two different solvent-free approaches of incorporating and dispersing CNCs into the PLA matrix were examined. The first approach consisted of melt-blending PLA and CNCs in an internal mixer whereas the second method involved direct dry-mixing of PLA and CNCs in a high intensity mixer, before film manufacture through the blown film extrusion process. Good distribution and barrier performance improvement were achieved by both methods. However, the direct dry-blending technique appeared to be the better approach for adding CNCs into the PLA matrix because it exposed the samples to less heat; thus, minimizing thermal degradation as demonstrated by the quantified number of chain scissions, molecular weight and melting temperature results.Thereafter, the influence of CNC addition level and environmental testing conditions on the water vapor (WVP) and oxygen (OP) permeability of direct dry-blended PLA/CNC films were studied. Both WVP and OP of PLA and PLA/CNC nanocomposite films varied exponentially with temperature as expected from the Arrhenius equation, whereas the WVP remained constant with relative humidity (RH) as expected from Fick's law. Additionally, the values of WVP and OP negatively correlated with the degree of crystallinity. Depending on testing temperature or humidity, optimum improvements in WVP (30-40%) and OP (65-75%) of PLA films occurred at 1% CNCs, a CNC content that correlated very well with the maximum increase in crystallinity.Finally, the potential of the developed PLA/1% CNC films with enhanced barrier performance in extending the shelf-life of a moisture-sensitive food product (crackers) was assessed and mathematically modeled. Interestingly, the crackers packaged in the CNC-based films had approximately 40% longer shelf-life compared to the ones packaged in neat PLA, irrespective of the RH. The overall results of this research indicate that the PLA/CNC films developed in this study have tremendous potential for food packaging applications.

Jointly published with INRA, Paris Plant proteins are regarded as versatile, functional ingredients or as active biological compounds, and as essential nutrients in food. Besides food uses, plant proteins are also considered as "green" chemical molecules useful in manufacturing non-food industrial products. This new utilization of plant proteins presents a great challenge for agriculture and industry and will also be beneficial for the environment. In this book, numerous scientists working on all aspects of proteins from the major European crops report on the role played by plant proteins in food systems and their effects on human health. In addition, the most recent data on protein-based plastic materials and other non-food products are presented.

The book will be focused on the three most important aspects of food packaging: Modeling, Materials and Packaging Strategies. The modeling section will provide a complete overview of mass transport phenomena in polymers intended for food packaging applications. The materials section will cover the most interesting problem-solving solutions in the field of food packaging, i.e., low environmental impact active films with antimicrobial activity. Lastly, the packaging section will provide an overview of the most recent approaches used to prolong the shelf life of several food products.

Film Properties of Plastics and Elastomers

Packaging for Food Preservation

Influence on Food Shelf Life Following Microwave-assisted Thermal Sterilization

D-limonene Permeability, Water Vapor Permeability, and Mechanical Properties

Multifunctional and Nanoreinforced Polymers for Food Packaging

Structure-property Relationships in High Barrier Multilayer Film/foam Systems

This e-book will review special features of the cerebral circulation and how they contribute to the physiology of the brain. It describes structural and functional properties of the cerebral circulation that are unique to the brain, an organ with high metabolic demands and the need for tight water and ion homeostasis. Autoregulation is pronounced in the brain, with myogenic, metabolic and neurogenic mechanisms contributing to maintain relatively constant blood flow during both increases and decreases in pressure. In addition, unlike peripheral

organs where the majority of vascular resistance resides in small arteries and arterioles, large extracranial and intracranial arteries contribute significantly to vascular resistance in the brain. The prominent role of large arteries in cerebrovascular resistance helps maintain blood flow and protect downstream vessels during changes in perfusion pressure. The cerebral endothelium is also unique in that its barrier properties are in some way more like epithelium than endothelium in the periphery. The cerebral endothelium, known as the blood-brain barrier, has specialized tight junctions that do not allow ions to pass freely and has very low hydraulic conductivity and transcellular transport. This special configuration modifies Starling's forces in the brain microcirculation such that ions retained in the vascular lumen oppose water movement due to hydrostatic pressure. Tight water regulation is necessary in the brain because it has limited capacity for expansion within the skull. Increased intracranial pressure due to vasogenic edema can cause severe neurologic complications and death.
Active polymer food packaging is packaging which has been designed to deliberately interact with food or with a direct food environment to reduce oxygen and moisture levels, preserve flavourings and the quality of the food. New concepts of active and intelligent packaging play an increasingly important role by offering numerous and innovative solutions for extending the shelf-life or for maintaining, improving or monitoring food quality and safety. This is the driving force for the food packaging industry's development of new and improved packaging concepts using nanoparticles.This book gives an overview of applications for various types of nanoparticles, such as different metal based substances, and explains their role in polymer food packaging.The book also elaborates the mechanism of activity of each type of nanoparticle, for example:- Antimicrobial activity- Oxygen absorption (scavengers)- Ultraviolet blocking properties- Water vapour permeabilityThe characterisation of polymer nanocomposite materials and the regulatory aspects of nanomaterials are also discussed.Information is provided about the polymers and polymer nanocomposites, and in addition, the book provides information about new food packaging materials with improved mechanical, barrier and antimicrobial properties to preserve the food during transport and storage.
This book focuses on the preparation and characterisation of polyvinyl alcohol (PVA)/ halloysite nanotube (HNT) bionanocomposite films with different HNT contents for potential use in food packaging. It examines the effect of material composition and nanofiller content on mechanical, thermal and optical properties in relation to their morphological structures, and also comprehensively describes the water resistance, biodegradation and migration rates of such bionanocomposites, as well as their barrier properties in terms of water vapour transmission, and water vapour, air and oxygen permeabilities. Further, this book discusses the use of Nielsen model and Cussler model to predict the relative permeability of bionanocomposites, demonstrating that Nielsen model is more effective and in better agreement with experimental data obtained. Lastly, it discusses the application of bionanocomposite films in food packaging to prolong the shelf life of freshly cut avocados and peaches.

Principles and Applications

Food Packaging

Processing, Properties, and Applications

Biopolymer Nanocomposites

Nanoparticles in Active Polymer Food Packaging

The Cerebral Circulation

This book is an updating of Food Packaging and Preservation, Theory and Practice published in 1986 by Elsevier Applied Science. Since that date, many things have changed in the world. Hence the name given to the first IFTEC meeting held at the Hague (NL), November 15-18, 1992 Food Technology for a Changing World. Is the world changing for better or worse and what can food technology improve? The keynote lecture of the IFTEC meeting dealt with hunger and the challenge it represents to food science and technology. In the preface to the 1986 book it was suggested that food packaging could solve some of the problems of crop preservation in countries where starvation is prevalent. However, such thoughts did not solve any problems. The famine is still spreading in Africa. The unbalanced north-south situation evoked in the 1986 preface has not improved. The international market of foods and agricultural products is constantly changing and food packaging scientists can only explore new ways to help cope with this. Some of these ideas are approached in this book, particularly in chapters 9, 10 and 12.

Sets forth the techniques needed to create a vast array of useful biopolymer nanocomposites Interest in biopolymer nanocomposites is soaring. Not only are they green and sustainable materials, they can also be used to develop a broad range of useful products with special properties, from therapeutics to coatings to packaging materials. With contributions from an international team of leading nanoscientists and materials researchers, this book draws together and reviews the most recent developments and techniques

in biopolymer nano-composites. It describes the preparation, processing, properties, and applications of bio- polymer nanocomposites developed from chitin, starch, and cellulose, three renewable resources. Biopolymer Nanocomposites features a logical organization and approach that make it easy for readers to take full advantage of the latest science and technology in designing these materials and developing new products and applications. It begins with a chapter reviewing our current understanding of bionanocomposites. Next, the book covers such topics as: Morphological and thermal investigations of chitin-based nanocomposites Applications of starch nanoparticle and starch-based bionanocomposites Spectroscopic characterization of renewable nanoparticles and their composites Nanocellulosic products and their applications Protein-based nanocomposites for food packaging Throughout the book, detailed case studies of industrial applications underscore the unique challenges and opportunities in developing and working with biopolymer nanocomposites. There are also plenty of figures to help readers fully grasp key concepts and techniques. Exploring the full range of applications, Biopolymer Nanocomposites is recommended for researchers in a broad range of industries and disciplines, including biomedical engineering, materials science, physical chemistry, chemical engineering, and polymer science. All readers will learn how to create green, sustainable products and applications using these tremendously versatile materials.

The optimum packaging material selection for in-package pasteurized food products is a complex process. Unlike sterilized food products where very high barrier packages are required to maintain longer shelf life at ambient conditions, medium/low barrier packages would be adequate for pasteurized products. Oxygen and water vapor barrier properties of packages are critical for retaining food quality during the storage and determining the shelf life. The objectives of this research were to understand: a) the sensitivities of different food components like vitamins, pigments, and lipids towards oxygen barrier properties of different packaging materials, b) the influence of thermal processing on package properties, and c) the potential of encapsulation in improving the storage stability of vitamin C. The first and second studies investigated the storage stability of natural colorants and vitamin C in pasteurized vegetable purees stored at 4-13oC towards packaging films with a range of oxygen transmission rates (OTR: 1-81 cm3 m-2 day-1 (cc). Betalains and vitamin C showed the highest sensitivity towards films OTR, while anthocyanins and [beta]-carotene were relatively stable. Chlorophylls continued to degrade irrespective of package OTR. The third study focused on the storage stability of encapsulated vitamin C and fat-soluble vitamins (A & E) in mashed potatoes at 5oC, and the effect of conventional (CP) and microwave-assisted thermal pasteurization (MAPS) on package properties. Encapsulation improved the storage stability of vitamin C in product packaged in low barrier packaging. Vitamins A and E showed excellent retention during storage regardless of selected packaging. Comparatively, greater changes in packaging barrier properties were observed in CP compared to MAPS. In the final study, the feasibility of biobased/biodegradable films with high OTRs (330-619 cc) was successfully assessed for in-package processing by selecting two different oxygensensitive recipes - beet mixed mashed potatoes and salmon in sauce. These findings can help in the selection of optimum packaging for in-package pasteurization of pigments and vitamin-rich products. Encapsulation demonstrated the significance in improving the storage retention of vitamin C. The study on biobased/biodegradable packaging extended the applications of these films to high moisture and in-package processed food products with ?10 days of shelf life.

Physical Properties of Whey Protein Isolate Films

Oxygen and Water Vapor Permeability and Required Layer Thickness for Barrier Packaging

Food Packaging Technology

Thin Al2O3 Barrier Coatings Grown on Bio-based Packaging Materials by Atomic Layer Deposition

Barrier Properties of Ethylene Vinyl Alcohol Films in Thermal Processing

Improved Water Resistance and Barrier Properties of Polyvinyl Alcohol With Polyurethane Siloxane Coating for Packaging Applications

Recent developments in multifunctional and nanoreinforced polymers have provided the opportunity to produce high barrier, active and intelligent food packaging which can help ensure, or even enhance, the quality and safety of packaged foods. Multifunctional and nanoreinforced polymers for food packaging provides a comprehensive review of novel polymers and polymer nanocomposites for

use in food packaging. After an introductory chapter, Part one discusses nanofillers for plastics in food packaging. Chapters explore the use of passive and active nanoclays and hidrotalcites, cellulose nanofillers and electrospun nanofibers and nanocapsules. Part two investigates high barrier plastics for food packaging. Chapters assess the transport and high barrier properties of food packaging polymers such as ethylene-norbornene copolymers and advanced single-site polyolefins, nylon-MXD6 resins and ethylene-vinyl alcohol copolymers before going on to explore recent advances in various plastic packaging technologies such as modified atmosphere packaging (MAP), nanoscale inorganic coatings and functional barriers against migration. Part three reviews active and bioactive plastics in food packaging. Chapters investigate silver-based antimicrobial polymers, the incorporation of antimicrobial/antioxidant natural extracts into polymeric films, and biaoctive food packaging strategies. Part four examines nanotechnology in sustainable plastics with chapters examining the food packaging applications of polylactic acid (PLA) nanocomposites, polyhydroxyalkanoates (PHAs), starch-based polymers, chitosan and carragenan polysaccharides and protein-based resins for packaging gluten (WG)-based materials. The final chapter presents the safety and regulatory aspects of plastics as food packaging materials. With its distinguished editor and international team of expert contributors Multifunctional and nanoreinforced polymers for food packaging proves a valuable resource for researchers in packaging in the food industry and polymer scientists interested in multifunctional and nanoreinforced materials. Provides a comprehensive review of novel polymers and polymer nanocomposites for use in food packaging Discusses nanofillers for plastics in food packaging including the use of passive and active nanoclays and hidrotalcites and electrospun nanofibers Investigates high barrier plastics for food packaging assessing recent advances in various plastic packaging technologies such as modified atmosphere packaging (MAP)

New evidence this year corroborates the rise in world hunger observed in this report last year, sending a warning that more action is needed if we aspire to end world hunger and malnutrition in all its forms by 2030. Updated estimates show the number of people who suffer from hunger has been growing over the past three years, returning to prevailing levels from almost a decade ago. Although progress continues to be made in reducing child stunting, over 22 percent of children under five years of age are still affected. Other forms of malnutrition are also growing: adult obesity continues to increase in countries irrespective of their income levels, and many countries are coping with multiple forms of malnutrition at the same time - overweight and obesity, as well as anaemia in women, and child stunting and wasting.

AbstractCHAPTER 1: In this study, multilayer films of sPS-PPS (syndiotactic Polystyrene and Polyphenylene sulfide blend) against P4MP1 [Poly (4-Methylpentene-1)] with various compositions and layer thicknesses were prepared by a layer multiplying co-extrusion process. Incorporating the PPS into sPS layers before co-extrusion produced pores in the sPS layers upon a post-extrusion, uniaxial orientation. Confined crystallization of P4MP1 by sPS-PPS was examined before and after the uniaxial orientation. A melt and recrystallization method was employed to achieve the preferred in-plane orientation of P4MP1 crystals. This was characterized by the atomic force microscopy and x-ray spectroscopy. We found that with P4MP1 layer thickness smaller than 400 nm, a confinement effect will induce in-plane P4MP1 crystal orientation where the crystal c-axis is perpendicular to the film. This arrangement of crystals reduced oxygen's tortuosity through the multilayer films. This conclusion was verified by increased oxygen permeability of the stretched-recrystallized multilayer films.CHAPTER 2: High-density polyethylene (HDPE) was co-extruded against high glassy transition temperature (Tg) polycarbonate (PC) to fabricate multilayer films. Melt and recrystallization experiments were conducted on these extruded films to study the effects of isothermal recrystallization temperature and layer thickness on HDPE lamellae orientation. WAXS and AFM were used to demonstrate lamellar morphology of HDPE layers. We report that HDPE lamellae show twisted morphology in 30 nm thin layers after confined crystallization at a high temperature (128 oC). It may be the first time that anyone has created such twisted lamellar morphology with HDPE in such a thin layer. Similar twisted morphology of HDPE was also observed when HDPE was co-extruded with another high Tg glassy polymer, polysulfone (PSF). Interestingly, the twisted HDPE lamellar morphology associated with an increased crystallinity improves both the oxygen and water vapor barrier properties of the multilayer films.CHAPTER 3: Confined crystallization of high-density polyethylene (HDPE) in multiplayer films is studied in this paper. A new cyclic olefin copolymer (COC), HP030, is co-extruded with HDPE by a layer multiplying technique. The number of layers and layer compositions are changed to study the effect of layer thickness on the crystalline morphology of the HDPE layers under

confinement. Atomic force microscopy (AFM) is used to investigate the crystalline morphology of the HDPE layers. MOCON ((Minneapolis, MN, commercial instrument) units are employed to measure both oxygen permeability and water vapor transport rate (WVTR) of these co-extruded HDPE/HP030 multilayer films. We report that when the HDPE layer nominal thickness is about 290 nm in the HDPE/HP030 multilayer films, the HDPE layer effective gas barrier property is improved approximately 2 times for oxygen and 5 times for water vapor. This is the result of confined spherulite morphology of HDPE, which increases the tortuosity for gas to diffuse through the films. Similar phenomenon is found for polypropylene (PP), when PP is co-extruded against polycarbonate (PC). The same experiments as for HDPE are conducted to confirm that PP spherulites have been confined by PC in PP/PC multilayer films. We discover that the confined spherulites of PP improve its gas barrier properties as well. CHAPTER 4: Blends of linear low density polyethylene (LLDPE) and ethylene vinyl alcohol (EVOH) with different weight fractions are extruded to fabricate thin films. The extruded blend film morphology is investigated by atomic force microscopy (AFM). The extruded blend films have shown extended morphology along the extrusion direction (ED) and dispersed morphology along the transverse direction (TD). We report that due to this morphology, a two-dimensional (2-D) confined crystallization occurs. The EVOH has successfully confined the LLDPE from both film normal direction (ND) and transverse direction (TD) in this study. The confinement from ND results in an on-edge orientation of LLDPE, while the confinement from TD forces the on-edge oriented LLDPE crystals to further elongate along the extrusion direction (ED). This specific crystal orientation is different from one-dimensional (1-D) confined crystallization observed in multilayered films. Both wide angle X-ray scattering (WAXS) and small angle x-ray scattering (SAXS) are utilized to investigate the crystal orientations of LLDPE in the extruded blend films. Moreover, due to the morphology, the extruded blend films have shown high oxygen barrier properties, which make this material valuable in packaging applications.CHAPTER 5: The blend of linear low-density polyethylene (LLDPE) and ethylene vinyl alcohol (EVOH) with weight fraction of 50-50 is extruded by a multiplication extrusion system to fabricate thin films. Different numbers of multipliers are utilized to tailor the morphology of the extruded blend films. We found that as the number of multipliers increases, the blend film morphology transforms from an elongated and layer-like structure to the co-continuous structure and eventually becomes homogeneous. This is because during the multiplication process, the multipliers behave similar to static mixers that physically break the elongated and co-continuous like structure of LLDPE and EVOH into tiny domains. As the morphology evolves, the physical properties of the extruded blend films change dramatically. After the co-continuous and elongated morphology becomes homogenous, both the gas permeability and the transmission rate of these films increase. The tensile mechanical behaviors become isotropic at different deformation directions. Atomic force microscopy (AFM) and wide angle X-ray scattering (WAXS) are utilized to investigate the morphology and crystalline structure of the blend films. Oxygen gas permeability and water vapor transport rate (WVTR) of these blend films are measured by MOCON units. The transmission rate and mechanical properties are studied by the UV-vis and a mechanical tensile stretcher (MTS) respectively.

Evaluating Performance of Flexible Packaging and Oxygen Sensitivity of Food Components

Effect of Flexing on the Barrier Properties of Metallized Films

Plant Proteins from European Crops

Active Food Packaging

Polyvinyl Alcohol/Halloysite Nanotube Bionanocomposites as Biodegradable Packaging Materials

Application of Oxygen Scavenger

The findings of this work can be used for selecting or designing proper polymeric packaging for MATS processed foods. It also provides preliminary shelf life information to conduct necessary prediction for commercial products of the similar category.

Biaxial (having two axes) stretching of film is used for a range of applications and is the primary manufacturing process by which products are produced for the food packaging industry. Biaxial stretching of film: principles and applications provides an overview of the manufacturing processes and range of applications for biaxially stretched films. Part one reviews the fundamental principles of biaxial stretching. After an introductory chapter which defines terms, chapters discuss equipment design and requirements, laboratory evaluations, biaxial film structures and typical industrial processes for the biaxial orientation of films. Additional topics include post production processing of biaxially stretched films, the stress-strain behaviour of poly(ethylene terephthalate) and academic investigations of biaxially stretched films. Part two investigates the applications of biaxial films including

fresh cut produce, snack packaging and product labelling. A final chapter investigates potential future trends for biaxially oriented films and orienting lines. Biaxial stretching of film: principles and applications is a valuable reference tool for a broad spectrum of readers, ranging from polymer and fibre engineers to electrical engineers. It will also be suitable for professionals in the food packaging and paper industries. A valuable reference tool for polymer and fibre engineers, electrical engineers and professionals in the food packaging and paper industries Provides a comprehensive overview of the manufacturing processes of biaxially stretched films and includes a discussion of their future applications Places emphasis on the technology as well as the different types of polymers used

The protection and preservation of a product, the launch of new products or re-launch of existing products, perception of added-value to products or services, and cost reduction in the supply chain are all objectives of food packaging. Taking into consideration the requirements specific to different products, how can one package successfully meet all of these goals? Food Packaging Technology provides a contemporary overview of food processing and packaging technologies. Covering the wide range of issues you face when developing innovative food packaging, the book includes: Food packaging strategy, design, and development Food biodeterioation and methods of preservation Packaged product quality and shelf life Logistical packaging for food marketing systems Packaging materials and processes The battle rages over which type of container should be used for which application. It is therefore necessary to consider which materials, or combination of materials and processes will best serve the market and enhance brand value. Food Packaging Technology gives you the tools to determine which form of packaging will meet your business goals without compromising the safety of your product.

Barrier Polymers and Structures

Modification of cellulose hydrate films to improve their barrier properties to water vapor and oxygen

Permeability of Lipid Films to Water Vapor and Oxygen

A Guide to Packaging and Barrier Materials

Regulation of Tissue Oxygenation, Second Edition

Gas Barrier Properties of Polymer Packaging

Thermoplastic foams nowadays are widely used in a variety of applications, such as packaging, construction, and the automotive industry because of their wide range of properties such as lightweight, excellent strength/weight ratio, insulation properties, energy absorption performance, and material cost. However, there are still issues on the gas barrier and mechanical properties in use because of the cellular structure. This work targeted to unveil the processing-structure-property relationships of three film/foam multilayer polymeric systems with diverse transport properties. The first part of the thesis (Chapter 2) focuses on the understanding of the effect of the number of layers and composition on mechanical properties and barrier properties of multilayer film/foam material with alternating ethylene-vinyl alcohol copolymer (EVOH) film layers and low-density polyethylene (LDPE) foam layers. Tensile properties of the film/foams at elevated temperatures were used to optimize thermoforming conditions. Uniaxial orientation was discovered as an efficient approach to evaluate the potential for thermoforming. Oxygen transmission showed a strong correlation with the thickness reduction which could be used as an indicator for barrier properties of the packaging materials. Film/foam materials with 32 layers demonstrated optimum performance with low oxygen transmission along with high drawing capability. In the third chapter, the previous system (Chapter 2) was innovated with high-density polyethylene (HDPE) skin layer. High oxygen and water vapor barrier film/foam system had been developed using multilayer co-extrusion technology. The film/foams contained alternating low-density polyethylene (LDPE) foam layers and ethylene-vinyl alcohol (EVOH) copolymer film layers with HDPE skin layer. The lightweight film/foams showed oxygen and water vapor transmission rate are correlated with the EVOH film layer and HDPE skin layer composition. The layered film/foam was successfully thermoformed at 80 °C with low oxygen transmission along with high drawing capability. The fourth chapter introduces a novel approach, to produce PLA/PLA multilayer film/foams structures having 16, 32, and 64 alternating layers. The lightweight multilayered PLA/PLA film/foam has a unique solid/porous alternating horizontal architecture, in which the film layers can effectively control the growth of the cells and suppress the premature rupture of cells during coextrusion process. Tensile properties at elevated temperatures of the PLA film were used to optimize thermoforming conditions. The effects of annealing temperature and time on the crystallinity and oxygen permeability of PLA/PLA multilayer film/foams were investigated. Oxygen transmission showed a strong correlation with the crystallinity of PLA/PLA multilayer film/foam. The material demonstrated high performance with low oxygen transmission which could be used as high barrier material.

The complete and authoritative guide to modern packaging technologies —updated and expanded From A to Z, The Wiley Encyclopedia of Packaging Technology, Third Edition covers all aspects of packaging technologies essential to the food and pharmaceutical industries, among others. This edition has been thoroughly updated and expanded to include important innovations and changes in materials, processes, and technologies that have occurred over the past decade. It is an invaluable resource for packaging technologists, scientists and engineers, students and educators, packaging material suppliers, packaging converters, packaging machinery manufacturers, processors, retailers, and regulatory agencies. In addition to updating and improving articles from the previous edition, new articles are also added to cover the recent advances and developments in packaging. Content new to this edition includes: Advanced packaging materials such as antimicrobial materials, biobased materials, nanocomposite materials, ceramic-coated films, and perforated films Advanced packaging technologies such as active and intelligent packaging, radio frequency identification (RFID), controlled release packaging, smart blending, nanotechnology, biosensor technology, and package integrity inspection Various aspects important to packaging such as sustainable packaging, migration, lipid oxidation, light protection, and intellectual property Contributions from experts in all-important aspects of packaging Extensive cross-referencing and easy-to-access information

on all subjects Large, double-column format for easy reference
Preface -- 1. Introduction to Plastics and Polymers -- 2. Chapter 2 - Introduction to the Mechanical, Thermal and Permeation Properties of Plastics and Elastomers -- 3. Production of films -- 4. Markets and Applications for films -- 5. Styrenic Plastics -- 6. Polyesters -- 8. Polyamides (Nylons) -- 9. Polyolefins -- 10. Polyvinyls & Acrylics -- 11. Fluoropolymers -- 12. High Temperature/High Performance Polymers -- 13. Elastomers and rubbers -- 14. Renewable Resource or biodegradable polymers -- Appendices -- Permeation Unit Conversion Factors -- Vapor Transmission rate Conversion factors.
The Effect of Neutralizing Cations on the Barrier Characteristics of a Surface Sulfonated Polystyrene Film
Food and Non-Food Applications
Effect of Plasticizer on Edible Film Properties
Poly(lactic Acid)/cellulose Nanocrystal Composite Blown Films for Food Packaging Applications

This book is arguably the first one focusing on packaging material testing and quality assurance. Food Packaging Materials: Testing & Quality Assurance provides information to help food scientists, polymer chemists, and packaging technologists find practical solutions to packaging defects and to develop innovative packaging materials for food products. Knowledge of packaging material testing procedures is extremely useful in the development of new packaging materials. Unique among books on packaging, this reference focuses on basic and practical approaches for testing packaging materials. A variety of packaging materials and technologies are being used, with glass, paper, metal, and plastics as the most important groups of materials. Material properties such as mechanical and other physical properties, permeability, sealing, and migration of substances upon food contact are determining factors for food quality, shelf life, and food safety. Therefore, food packaging materials have to be tested to ensure that they have correct properties in terms of permeability for gases, water vapor, and contaminants; of mechanical and other physical properties; and of the thickness of main components and coating layers. This book has been designed to shed light on food packaging material testing in view of packaging integrity, shelf life of products, and conformity with current regulations. This comprehensive book, written by a team of specialists in the specific areas of food packaging, package testing, and food contact regulations, deals with the problems in a series of well-defined chapters. It covers the relations between packaging properties and shelf life of products and describes testing methods for plastics, metal, glass, and paper, including the areas of vibration, permeation, and migration tests. It will be of benefit for students, scientists, and professionals in the area of food packaging. This volume provides a comprehensive treatment of the state of science and technology in the area of barrier polymers and barrier structures. Among the topics covered in its 20 chapters are structure-property relationships of Saran materials and nylons; approaches to engineering around the sensitivity of barrier polymers to humidity; characterization of sorption kinetics in several glassy polymers for a broad spectrum of penetrants; complex barrier structures; and flavor scalping. It presents fundamental principles along with complementing discussions of applications of these principles.