Symposium 2

Films and Fibers

S02-234

Continuous Solution-Casting of Polymer Electrolyte Membranes and Effects of Casting Conditions on the Properties of the Membranes

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A continuous solution film casting process was studied for manufacturing sulfonated poly(arylene ether sulfone) copolymer membranes including random and block systems with various compositions. A small-scale reverse roll casting machine capable of handling as little as 5 gram of polymer samples was built and used to cast membranes with thickness of 10 to 50 microns. The properties and morphology of the films were measured and compared with those of hand casting films. The result showed that the casting and drying conditions including solvent type, initial polymer concentration, drying temperature and air flow rate might have a significant impact on the properties of the membranes. Compared to random copolymers, block copolymers were found to be much more sensitive to the drying conditions. The design of the solvent removal process required knowledge of the kinetics of phase separation which occurred during the drying process.

S02-355

The development of voidage and capillary size within extruded plastic films

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Microcapillary films (MCFs) are new, innovative, polymer films that contain a one-dimensional array of capillaries running continuously along the material's length, with capillary mean hydraulic diameters ranging between 100 µm and 400 µm. This extrudate has been manufactured by the entrainment of gas into a polymer melt via nozzles positioned within an extrusion die [1]. The original MCF geometry contains roughly 15% voidage on an area basis and has certain advantages for applications such as microreactors [2] and heat exchangers [3]; however there is application potential for both smaller diameter capillaries and higher voidage. We have discovered different downstream processing conditions for producing both different capillary diameters and voidages within MCFs. The isotropic characteristics of the original, low-voidage, MCF manufactured from a linear low density polyethylene (LLDPE) allows for its transformation to small diameter low-voidage MCF by using the necking characteristics of the polymer by mechanical drawing in the machine direction. Capillary diameters for LLDPE of 7 µm have been achieved. It has also been found that during processing, the use of rapid quenching combined with pressure injection allows the creation of a high voidage MCF [4]. The anisotropic characteristics of this high-voidage MCF exhibit a brittle mechanical behaviour along the capillary direction, however, by drawing in a transverse direction, an unexpected non-uniform deformation mechanism was discovered to produce an ultra-high-voidage MCF. This presentation will provide experiment details on processing procedure, mechanical drawing and X-ray behaviour of the processed material.To be submitted Polymer (2007)1.Hallmark B., et al., J. Non-Newton. Fluid 2005. 2.Hornung C.H., et al., Org Process Res Dev 2007. 3.Hornung C.H., et al., J. Micromech Microeng. 2006. 4.Hallmark B., et al., 23rd Annual Meeting of PPS, 2007.

S02-1179

Evaluation of structure development and stretchability during the stretching process for various polypropylenes

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The structure development and stretchability of various kinds of polypropylenes during the stretching process were evaluated by using in-situ observation such as the light scattering, the birefringence and the small angle X-ray scattering. As the samples of polypropylenes, molecular design such as tacticity, molecular weight, molecular weight distribution and long chain branching were changed. And furthermore very low tacticity polypropylenes were added to the standard stretching polypropylene grade.It was found that there are three stretching regions existed during the uni-axial stretching process. In the first region, the stress increased with increasing stretching strain, but the spherulite was not broken up and the birefringence did not increase very much. In the second region, the spherulite was broken up and the birefringence increased with increasing strain ratio. In the third region, stretching stress increased gradually and the birefringence reached to the maximum value.From stress and strain curve, high tacticity polypropylene showed high stress and clear yield value at the initial stretching strain and had large spherulite size. Molecular weight distribution made no big difference at the yield value, but the stretching stress at the larger stretching ratio decreased with increasing molecular weight distribution. The polypropylene blended with very low tacticity polypropylene showed, like low tacticity polypropylene, low stretching stress at the yield value.In addition, the stretching in the transverse direction after the stretching in the machine direction was also studied for various polymer designs. From the experimental results, it is found that the structure development of various polypropylenes during the stretching process could be evaluated and then the polymer for the good stretchiability and film uniformity could be designed with the small amount of sample and short time.

S02-1244

Processing/Structure/Properties relationships in Polyethylene Blown Films

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Processing/Structure/Properties relationships in Polyethylene Blown FilmsPierre G. Lafleur1 , Shokoh Fatahi1 and Abdellah Ajji21École Polytechnique de Montréal, Chemical Engineering Department, CRASPCP 6079,Succ. Centre-ville, Montréal ,Québec, H3C 3A7 Canada2Industrial Materials Institute, NRC, 75 Boul. De Mortagne, BouchervilleQuébec, QC, J4B 6Y4 Canada.AbstractSeveral authors have investigated polyethylene molecular structure, processing and property relationships in order to predict the end use properties of blown films. However, at present, a simple model does not exist to quantitavely predict blown film properties based on microstructure and morphology development. In this work, a wide range of PE materials, including LLDPE, two different HDPEs and LDPE were used. A series of blown films were produced by varying three key parameters: take-up ratio (TUR), blow-up ratio (BUR), and frost line height (FLH). The tensile properties of the resulting films were investigated in relation to their microstructure characteristics. The orientation parameters of the films were measured by XRD and birefringence. They were determined for both crystalline and amorphous phases. The crystalline content, the lamellar thickness and crystal sizes were obtained from DSC and WAXS pole figure technique. The SAXS technique was used to find the average length of the crystal and amorphous layers. A model for the tensile modulus was proposed and correlated to some structural parameters including crystalinity, orientation factors for crystalline c-axis and amorphous phase, lamellar thickness and crystal size. The measured modulus and calculated one were compared and a reasonable agreement was found between them.

S02-127

Analysis of the Mechanism of Pore Development in Cold Drawn Poly(ethylene terephthalate) Fibres.

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Poly(ethylene terephthalate) fibres become lustrous under conditions of high draw ratio during the process of cold drawing because of the formation of pores within the structure. The influence of processing parameters and material effects on the formation of pores was elucidated. Properties such as fibre density and diameter were considered to be pore-sensitive as their relationship with the draw ratio was altered when the fibres became porous. A critical draw ratio for pore formation was thus identified. Pores were seen to develop initially at the fibre centre. Their distribution spread over the entire cross-section of the fibre as the draw ratio was increased above the critical draw ratio. The pores which formed were long and narrow with tapered ends and were aligned with the fibre axis. They contained cross-walls perpendicular to the pore axis. Increasing the fibre wind-up speed or reducing the drawing rate had the effect of reducing the value of the critical draw ratio. The use of polymer blends decreased the value of the critical draw ratio by introducing discontinuities into the fibre structure in the form of polymer-polymer interfaces. These flaws were seen to act as generation points for pores.Pore formation had the effect of reducing the increase in fibre free energy associated with the drawing process. Porous fibres became an energetically favoured product above the critical draw ratio. The neck region experienced a triaxial state of stress during the drawing process which involved an outward-acting force. The value of this force was seen to be significantly increased as the fibre was drawn at draw ratio levels approaching the critical draw ratio. This caused the material to fail at discontinuities in the structure resulting in the formation of voids.

S02-146

Dual Electrode Mode Electro-spinning

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A novel, high speed electro-spinning process, dual electrode mode electro-spinning, was developed in this study. With coexistence of both positively and negatively charged nozzles, the electro-spun fibers interact and bridge grafting between nozzles, interconnect with each other, and are stretched on a movable collecting roll. By electro-spinning the biodegradable polymer via the dual electrode mode process, the results showed that a highly intertwined, 3D isotropic network structure was obtained. Moreover, the productivity was increased more than 170 times compared to that using the conventional single electrode mode process, which is essential for commercialization of the electro-spinning process.

S02-173

Rethinking the Mathematical Modeling of Film Blowing

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There have been numerous publications on simulation of the bubble formation process in the film blowing process.Unfortunately, these efforts have had very little impact on actual equipment and process design or process optimization.Equipment designers and processors rely on past experience and trial and error without recourse to any of the mathematical models that have been proposed. While spiral dies for blown film extrusion are designed by use of simulation software, there is nothing equivalent that could be of any practical use in bubble formation models for the prediction of the resulting film properties.It is argued in this paper, that the attempts to predict bubble shape have very little in common with industrial film blowing operations.The bubble shape is decided by the operators and determined by mechanical manipulations,through bubble guides, stabilizing cages and the aerodynanmics of cooling. It is proposed that by approximating the bubble shapes dictated by bubble management systems and the aerodynamics of cooling, it is possible to determine the stress distributions in the stretched film which is cooled, and eventually to predict some end-use properties.This approach may eventually also lead to understanding and hopefully predicting bubble stability,which is not the case with the numerous studies available in the literature.Incorporation of extensional viscosity models and experimental parameter determination will be crucial in these efforts.

S02-190

Nano and Micro Fibers for Conductive and Piezoelectric Applications

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The most widely used fiber process is the fiber spinning process. Electrospinning, in which fiber formation is due to the presence of an electric field, is more and more used, in particular for the production of nanofibres, which present significant potential for various applications; among which are, sensors, filters, biomedical, functional textiles etc. On the other hand, polymer nanocomposites (PNCs) have attracted much attention in recent years because of their potential low cost, ready availability, and their high aspect ratio, which can maximize the reinforcing effect in terms of mechanical, thermal, electrical, and barrier properties. PNCs also present an extraordinary opportunity for polymers to be used in biomedical applications, in light of their improved structural (mechanical, thermal, etc.) and functional properties (electric, magnetic, biologic, etc.). In this study, fibers obtained from the electrospinning process as well as melt spun fibers from polymers and nanocomposites, particularly polyvinyl fluoride (PVDF) and its blends with carbon nanotubes (PVDF/CNT) will be discussed in terms of the effect of material and process parameters. Their structure and performance will be also discussed as well as some applications. Techniques such as X-ray diffraction and SEM microscopy were used to determine the structure of the fibers.

S02-326

INFLUENCE OF THERMO-MECHANICAL HISTORY ON ADHESION IN MULTILAYERED BLOWN FILMS

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Coextrusion technologies allow the combination of several different polymers in order to fulfil sophisticated technical requirements including both mechanical and physical/chemical properties such as impact resistance or moisture/oxygen barrier performances. Since these polymers are usually incompatible, adhesive layers also called tie layers have been developed to improve adhesion between functional layers in extrusion technologies (film, sheet, pipe, blow molding). Adhesion is provided by both chemical and physical bonding. Its efficiency is very sensitive to the processing conditions, because both chemical reaction kinetics at interface and film microstructure will be impacted.Blown film coextrusion is a very popular technology in the packaging industry, thanks to its high versatility. However, in addition to rheological limitations to maintain bubble stability and prevent from coextrusion waves, thermal history is very complex as a result of many processing parameters: cooling temperatures, cooling ring design, internal bubble cooling, frost line height, line speed, melt temperature… As a consequence of this complex cooling, it is often difficult to reproduce adhesion levels on a similar structure from one line to another. Dimensionless parameters were defined, based on the contact time between layers and chemical bonds density, in order to anticipate peeling strength at interfaces.

S02-376

Parameters affecting the microstructure development in PP/PA6/Organoclay nanocomposites based fibers

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An attempt was made to study the relationship between the microstructure of PP/PA6/Organoclay blend samples and PA fibril formation in the fibers produced from the same blends. Polymer blend nanocomposite samples with the same blend ratio of PP/PA (80/20) and organoclay concentration (2.5%wt) without and with maleic anhydride grafted polypropylene (5%wt) were considered. Polymer blend nanocomposite samples were prepared by using a co-rotating twin-screw extruder and melt drawn into fibers by melt-spinning process. The XRD results showed a considerable amount of melt intercalation in the nanocomposit samples with greater extent for compatibilized nanocomposit samples. The results of the melt linear viscoelastic measurements performed on the polymer blend nanocomposite samples showed a pronounced low frequency nonterminal behaviour in storage modulus whose extent was found to be greater in compatibilized nanocomposite samples. A similar viscoealstic behavior was observed at temperature below the PA melting point. These results indicated that although a portion of organoclay is distributed in PA dispersed phase, a fraction of organoclay in the form of tactoids or individual platelets may also be conveyed into the interphase and/or into the PP matrix. This was evidenced by SEM micrographs which show much smaller PA particle size for polymer blend nanocomposite samples compared to simple blend as a result of enhanced interfacial interaction and reducing of coalescence caused by organoclay platelets. The enhanced interfacial interaction and existing of anisometric tactoids or individual platelets was found to facilate the fibrillation of PA disperse phase in fibers. Moreover, The XRD results showed a greater extent of melt intercalation process in polymer blend nanocomposite fibers compare to blend samples. This could be explained in terms of additional elongation imposed on the sample during the melt spinning process. It was demonstrated there is a strong relationship

S02-395

Finite Element Analysis for PET Sheet Forming with a Rolling-Drawing Hybrid Method

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The rolling method is known as a representative sheet metal forming method, which is hard to be applied to a plastic sheet because of its poor surface appearance. On the other hand, the drawing method by the speed difference between rolls is widely known as a uniaxial stretching method of plastic sheet, which causes a decrease in sheet width due to a neck-in phenomenon. The rolling-drawing hybrid method has been proposed for a plastic sheet in order to improve their disadvantages, where a sheet passes through the clearance between a pair of rolls thinner than sheet thickness while being drawn at a higher than pair-rolls speed. The rolling-drawing hybrid method has the following advantages over a conventional uniaxial stretching method of plastic films, which can be applied to a thick sheet and produce a sheet with high-modulus and high-strength due to the easy high stretching ratio under a small decrease in sheet width and is composed of comparatively simple and inexpensive equipments. The rolling-drawing hybrid method has been going into practical use from these advantages but there is a lot of uncertainty about the deformation behavior of plastic sheet and the optimum manufacturing conditions in the rolling-drawing hybrid process. Therefore, a new finite element analysis model has been proposed in this work in order to predict the deformation behavior of PET sheet during hybrid rolling-drawing and obtain the optimum design information on dimensions and manufacturing conditions in scaling-up. A constitutive equation dependent on temperature and strain has been determined from the experimental stress-strain curves of PET sheet under various temperatures and strains. It is confirmed that the proposed model can give good predictions about the deformation behavior of PET in the rolling-drawing hybrid process and an experimental elastic modulus of PET sheet seems to be related to a calculated equivalent strain by an FEM.

S02-403

Prediction of Internal Stresses during Film Winding Accompanied by Air-Entrainment

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A line speed of plastic film has become higher because of the increase in productivity so that a film winding speed also has become higher year by year. At higher speeds, more air is entrained with film and wound into the roll which acts as a lubricant between the layers of film. The layers of air make the wound roll unstable and cause poor roll formation and deformation of plastic film. During storage, interlayer pressures due to air can change relative to the pressures generated during winding. These changes can lead to problems such as film blocking, roll shifting and roll collapse.It has been tried to prevent these problems with empirical control of winding conditions such as a winding tension by trial and error. It is, however, desired to elucidate the generation mechanism of failures and predict the optimum winding conditions without failure in advance. In order to solve these problems, a new wound roll stress model including air-entrainment is proposed and applied to predict the internal stresses during film winding in this work. The predicted results obtained from the model have been compared with the experimental ones estimated from the winding density distribution in the roll measured by an ultrasonic-wave method.

S02-533

FILM BLOWING OF MODIFIED POLYETHYLENE

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We studied the effect of grafting of vinyltriethoxylene (VTES) onto polyethylene with the help of small quantities of peroxides has been investigated in order to use these materials in film-blowing operations. The degree of cross-linking has been kept very low to achieve good melt processability and improved mechanical properties.A water treatment of the films can allows to improve the properties of the film without affecting the film-blow processability. The modification of LDPE has been followed by mechanical and rheological tests, by extraction tests using p-xylene as solvent and by calorimetric analyses.The presence of small quantities of peroxide (0.05 %) leads to some increase of the viscosity. In particular, all the modified samples with and without water treatment show values of the dimensionless viscosity which are close each other in the range of 100-300 rad/s. In fact, the insoluble fraction of no-water treated modified films remain at a low level, in particular, under one percent. A significant increase of the gel content is obtained after the water treatment of the VTES/DCP modified film.The variations of the main mechanical properties of the films are very important, from one applicative point of view. For both extrusion directions (machine and transverse direction), the elastic modulus of the films increases with increasing the VTES concentration and even more by adding the small quantity of peroxide. Some reduction of the tensile strength and the elongation at break is observed, but these reductions are not considerable.

S02-576

SPINNING, STRUCTURE AND PROPERTIES OF POLYPROPYLENE/BOEHMITE COMPOSITE FIBRES

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In this paper, the effect of axial deformation of polypropylene (PP)/Boehmite composite fibres at spinning and drawing on their thermal properties, supermolecular structure, orientation and mechanical properties is presented. The commercial Boehmites, “Disperal” types and selected compatibilisers-dispersants were used for preparation of the PP (nano)composite fibres by melt spinning. The rheological properties of PP/Boehmite composites were evaluated using extruder-capillary rheoviscosimeter. The supermolecular structure of the PP/Boehmite fibres was investigated by DSC analysis and X-ray diffraction (WAXS). DSC measurements were carried out using conventional method (CM) and constant length method (CLM) in which the fibres with constant length during measurement were assured. The morphology was investigated by SEM and AFM methods.The parameters of the thermal properties and supermolecular structure of fibres were correlated with their basic mechanical properties, such as tenacity, Young’s modulus and elongation at break. The average melting temperature of fibres has increased proportionally with drawing ratio of PP and PP/Boehmite composite fibres. Boehmites used facilitated the deformation and orientation of PP fibres at drawing and enhanced their tensile strength and Young’s modulus at concentration 0.02-1.0 wt%, in comparison with virgin PP fibres. Tensile strength and Young’s modulus of the PP/Boehmite composite fibres increased gradually with their melting temperature and melting enthalpy.Furthermore, the thermal and light stability of the PP/Boehmite fibres as well as UV protection factor of the knitted model textiles were evaluated in dependence on Boehmite content in the fibres.

S02-634

Analysis of Free Surface Flow in Extrusion Film Casting Using Experiments and Simulations

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Extrusion film casting is an important melt processing technique that is used to produce several thousands of tons of polymer films on an industrial scale. We are interested in understanding quantitatively how macromolecular chain architecture influences the performance of melt processing operations such as extrusion film casting. The present research has been directed at the analysis of free surface flow in extrusion film casting using a synergistic approach of experiments and simulations. In extrusion film casting of polymeric resins (such as LLDPE), the free surface melt flow occurs in the gap between the cast-film die exit and the take-up roller (which is usually chilled). The cast film experiences necking (in width) and drawdown (in thickness) in this free-surface flow region. We have used polyethylene (PE) resins of different molecular architectures to produce extrusion cast films under controlled conditions. The PE resins include high-density, low-density, and linear-low density commercial resins. The necking in films during casting was monitored using a video camera and the width profiles were quantified for each resin. Free-surface flow simulations were carried out using an Arbitrary Lagrangian Eulerian (ALE) based finite element method. We present comparison of simulated necking and drawdown profile with the experimental results.

S02-875

Microporous Membranes Obtained from Polypropylene Blend Films by Stretching

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Blends of two linear polypropylenes (having different molecular weights) were prepared to develop microporous membranes through melt extrusion followed by stretching (named as cast film process). The role of high molecular weight chains on the row-nucleated lamellar crystallization was investigated. The orientation of crystalline and amorphous phases was measured by WAXD (wide angle X-ray diffraction) and FTIR (Fourier transform infrared). Long period spacing as well as the lamellae thickness were obtained using SAXS (small angle X-ray spectroscopy). The effects of annealing time, annealing temperature, applied extension during annealing, and processing parameters (die temperature and draw ratio) on crystallinity and thermal behaviour of films were studied using DSC (differential scanning calorimetry). It was found that annealing at 140 oC contributed significantly to the perfection of the crystalline phase. SEM micrographs of the surface of membranes show more uniform pore size and distribution morphology as the amount of high molecular weight species increases. Blending improves water vapour permeability of the membranes, suggesting increasing of interconnectivity of the pores. Tensile properties in machine and transverse directions as well as puncture resistance in normal directions were evaluated to examine the effect of orientation on the mechanical properties of polymer blends.

S02-886

Polypropylene Composites Reinforced with Surface Treated Microcrystalline Cellulose: Enhanced Compatibility and Creep Resistance

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Improvement of PP strength can be achieved by reinforcing particulates. Fibres impart a reinforcing function, with those of natural origin offering a cost effective and renewable alternative to synthetic counterparts. Cellulosic fibres provide a renewable source for use in composite materials, with implications in reducing environmental impact as they are extracted from agricultural plant sources. Cellulose is a linear biopolymer consisting of D-anhydroglucopyranose units joined by β-1,4-glycosidic bonds. Hydrolysis of wood pulp with mineral acids causes extraction of impurities such as lignin, pectin and hemicelluloses, and preferential hydrolysis of amorphous cellulose, leaving highly crystalline (~98 %) whiskers or micro-fibres. Microcrystalline cellulose (MCC) is relatively free from organic and inorganic contaminants, of high strength and stiffness due to high crystallinity, and therefore MCC is suitable for reinforcement.The interface between PP and MCC requires compatibilisation due to their difference in polarity. MCC was surface treated with various regents to improve the interfacial compatibility. The reagents included a dialkyltitanate and polypropylene-g-maleic anhydride (PP-g-MA). Thermal stability of MCC was increased in the composites and with the presence of PP-g-MA. MCC fibres increased the nucleation density, though no transcrystallinity was observed. Lack of transcrystallinity was due to the cellulose type II crystalline structure of MCC. The main influence of surface modification was observed in the thermo-mechanical properties. The fibres imparted stiffness to the matrix and reduced creep deformation. This is attributed to the bonding of PP to the surface treated MCC, especially with dialkyltitantate treatment. Further enhancement was provided when both the alkyltitanate coupling agent and PP-g-MA were present in the composite. The combination of surface treated MCC and PP-g-MA increased the resistance to flow.

S02-1041

Effect of Blown Film Processing Conditions on Crystalline Orientation and Barrier Properties in Octene LLDPE and HDPE films

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Polyethylenes produced in a dual reactor, solution process exhibit unique morphological and processing characteristics. Two examples will be reported in this paper. The first example reports on a Ziegler Natta catalyzed Linear Low Density PE (ZN-LLDPE), the second example on a single site catalyzed HDPE (sHDPE). Polyethylene films were produced on commercial scale blown film line under various processing conditions resulting in different draw and orientation levels. Oxygen and moisture permeation rates through the test films were measured. Permeation rates are discussed in terms of crystalline platelet orientation. For the ZN-LLDPE and its blends with High Pressure Low Density PE (LDPE), surprisingly high permeation values were measured in highly oriented films. While PE film permeability rates typically decrease with increasing orientation, orientation in low crystallinity PE may align crystalline platelets parallel to the direction of permeant flow effectively increasing oxygen and moisture transmission rates. It is shown that by increasing film draw-rate to maximize TD crystalline orientation and selectively blending LDPE to maintain orientation, the permeability of Octene LLDPE can be increased significantly.The results for the sHDPE showed that extrusion conditions or orientation had minimal effect on barrier properties. These findings are supported by the consistency of the crystalline orientation structures. The observations are attributed to the unique combination crystallization rates, relaxation times and molecular architecture of sHDPE.

S02-1213

ENHANCED FUNCTIONALITY IN TEXTILE FIBRES CONTAINING NANO-FILLERS

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Forming part of a large EU-funded programme, the incorporation of nano-fillers into PET fibres is being studied in order to enhance their functional properties and thereby extend their range of application. In this paper, emphasis is given to PET (in virgin and recycled form) incorporating naturally-occurring silicate layer nanoclays, synthetic fluoromica and nano-platelets derived from expandable graphite. The relative influence of these fillers on PET degradation is considered, together with means for minimizing this effect during melt processing. Mechanical properties of both injection moulded plaques and fibres drawn from a capillary rheometer were significantly improved at low additive loadings, which was associated with partial exfoliation of the fillers and substantiated by TEM and XRD analysis. It was also evident that the extensional deformation induced by fibre drawing increased the apparent degree of filler exfoliation and particle alignment. Electrical conductivity of PET filled with nano-graphite platelets, prepared by different routes is discussed in terms of particle size, loading, exfoliation and platelet orientation. Differences between fluoromica and graphite nano-particles on PET crystallization kinetics are also discussed.

S02-1242

Influence of fibers modification on properties of polylactid acid-cellulose fibers composites

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Polymer materials manufactured from natural resources have been investigated. Polylactid acid (PLA) was used as a major component in biocomposites, which were filled with cellulose fibers (flax, hemp). Polylactic acid is a biodegradable, thermoplastic, aliphatic polyester derived of renewable resources. PLA is useful in the packaging, electrical and automotive industry, at which the biodegradable materials started competing with cheaper synthetic plastics. One of the bigger difficulties of the composites reinforced with natural fibres is a lack of adhesion between the fibres and polymer matrix. Enhancement of the adhesion is possible by modifying the fibre surface for rendering it rougher for a better mechanical fastening or creating a better chemical liaison between the fibres and the matrix molecules. The efficiency of physical and chemical treatment of natural fibers have been studied. Mechanical and thermal properties, as well as a structure of the biocomposites was presented as a function of the matrix material and the filler content. Biocomposites display combined features of all components or markedly higher characteristics resulting from mutual interactions between the components.

S02-191

PVDF Films Structure: Effect of Preparation Conditions and Clay.

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Three Polyvinylidene fluoride (PVDF) different in molecular structure were used to produce Nanocomposities films with a particular emphasis on maximizing the β crystal phase content. The PVDF/clay compounding followed by cast film production was carried out through melt extrusion using a twin screw extruder equipped with a slit die. X-ray diffraction (XRD) results showed that clay melt intercalation is almost similar for all three PVDFs. The XRD results showed also that nanocomposite films from PVDF with branched chain structure (PVDFB) generated the greatest amount of β phase. FTIR spectroscopy measurements confirmed the XRD results but also revealed that significant stretching of the films or rapid cooling of the melt at the die would adversely affect the formation of β phase. The amount of β phase obtained based on Nanoclay compounding was compared with that obtained from stretching of moulded PVDF film with initial α phase. Stretching at 60°C yielded pure β phase, i.e. complete transformation of α to β. However the amount of β phase obtained by stretching was comparable to that obtained from Nanoclay compounding of the films. Upon tensile testing, PVDF with low molecular weight exhibited a very low strength while branched PVDF and high molecular weight PVDF could sustain more strain.

S02-276

Halogen free flame retardants for films

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Thermoplastics and organics composites have as intrinsic characteristics the tendency to burn when exposed to high temperatures. The flamability can be low in the case of the PVC and all plastics materials containing halogens (fluorine, chlorine, bromine and iodine), and high in the case of the derivatives of cellulose and oil.Flame retardants should inhibit, delay or eliminate the combustion process, getting the final product safer. Depending on polymer and tests of security against the fire, flame retardants act in several stages of the combustion process: heating, decomposition, ignition, propagation of the flame and smoke development. They act chemically or physically during the process of burning with several reactions simultaneously.The objective of this work was develop halogen free masterbatch of flame retardant for films and study the additive influence in the mechanical properties of the final product.After realized flamability tests, were concluded that 1% of active principle in transparent films was enough to get the classification of VTM-0 in accordance with UL 94.Colorful films were produced with organic and inorganic pigments, with and without flame retardant additive for flammability and mechanical tests.The results of flammability tests concluded that for colored films, concentration of 2% of active principle was necessary to get classification VTM-0 in accordance with UL 94.In accordance with the mechanical tests, the conclusion was that the results with or without flame retardants additive were similar. Therefore the halogen free flame retardant doesn´t affect the mechanical properties of films (for the recommended applications).

S02-283

Dynamic-mechanical and thermal properties of Poly (3-Hydroxybutyrate) / Wood Flour Films

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Biodegradable polymers have received an increased interest for utilization due to increasing environmentally aware consumers, increased price of crude oil and global warming. Nowadays, biodegradable polymers are used with a number of applications, such as therapeutic aids, medicines, coatings, food products and packaging materials. Poly (3-hydroxybutyrate) (PHB) is a biodegradable polymer, which occurs in nature and can also be synthesized in vitro. The goal of this work was to compare dynamic-mechanical and thermal properties of polyhydroxybutyrate (PHB) films reinforced with 5wt% of softwood or hardwood flour, modified with acidic or alkaline treatment and silanization. The composites were prepared by coprecipitation followed by thermocompression. The obtained results showed that PHB films reinforced by the softwood flour and treated with hydrolysis and silanization exhibited the best dynamic-mechanical properties and thermal stability. Our work was supported by the Austrian Science Fund (project No. L319-B16).

S02-284

EFFECT OF SURFACE TREATMENT AND PREPARATION METHOD ON THE PROPERTIES OF POLYLACTIC ACID-WOOD FLOUR FILMS

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The goal of this work was to compare thermal and dynamic-mechanical properties of polylactic acid (PLA) films reinforced with 5wt% of softwood flour, modified by silanization, esterification, oligoesterification, acide or alkaline treatment. The composites were prepared by the cooprecipitation followed with thermocompression as a first method, and solvent-casting methods as a second method. Films prepared by themocompression exhibited higher storage modulus with high tanδ and lower crystallinity in comparison with those of solvent-casting. Moreover, films prepared by thermocompression exhibited higher thermal stability. PLA films with softwood flour treated by hydrolysis exhibited the best dynamic-mechanical properties. This work received support by the Austrian Science Fund (project no. L319-B16)

S02-363

Ultradrawing Properties of Ultra-high Molecular Weight Polyethylene / Carbon Nanotube Fibers Prepared at Varying Formation Temperatures

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The compositions of ultrahigh-molecular-weight polyethylene (UHMWPE) and carbon nanotubes (CNTs) added gel solutions and spinning formation temperatures exhibited significant influence on the drawability, percentage crystallinity, melting temperature, birefringence and cross-section area morphology of the corresponding as-prepared UHMWPE/CNTs fibers. The achievable draw ratios (Dra) of UHMWPE/CNTs as-prepared fibers prepared near the optimum concentration improve consistently as their CNTs concentrations increase up to an optimum value. Moreover, the Dra values of the UHMWPE/CNTs fiber specimens prepared using the optimum composition of the UHMWPE/CNTs gel solutions improve significantly as their spinning formation temperatures reduce to an optimum temperature at 5°C. In fact, the Dra value of UHMWPE/CNTs fiber specimen prepared using the optimum composition and formation temperature is more than 120 % higher than those of the UHMWPE as-prepared fiber specimen prepared at the optimum concentration and formation temperature. In order to understand these interesting drawing properties of the UHMWPE and UHMWPE/CNTs as-prepared fibers, the birefringence, thermal, morphological and tensile properties of the as-prepared and drawn fibers were investigated. Possible mechanisms accounting for these interesting properties are proposed.ACKNOWLEDGEMENTS: The authors would like to express their appreciation to the Department of Industrial Technology, Ministry of Economic Affairs (95-EC-17-A-11-S1-057) and National Science Council (NSC 95-2221-E-253 -008 -MY3) for support of this work.

S02-399

SIMULATION FOR A DRYING PROCESS OF SOLVENT CAST FILMS

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In the drying process of solvent cast films, the products are manufactured from the removal of solvent with a dryer. The optimum drying conditions such as the temperature and velocity of blowing gas, running speed of film and so on are determined after much trial and error with much time, cost and labor. Though the change of residual solvent concentration in film during drying, its distribution in the film thickness direction and the film thickness exerts a profound influence on the characteristics of film, it is very difficult to obtain them by experiments. Therefore, it is desired to predict them by computer simulations but the authors cannot find the reports on the simulation for a drying process of solvent cast film. A new simulation model for a drying process of solvent cast films has been proposed in this work, which can predict the behavior of the film temperature and thickness, the averages of solvent concentration and diffusion coefficient, their distribution in the thickness direction and so on at any given position of running film in a drying process. The simulations have been attempted for a kind of polyimide film composed of a polyamic acid and dimethylacetamide (DMAc) system in this work. A diffusion coefficient is very important in the simulation for a drying process of solvent cast films. However, the diffusion coefficient of solvent in this system cannot be found in literature. Therefore, the diffusion coefficient of DMAc in this system is newly measured by the desorption experiment with a quartz-spring. The dependence of diffusion coefficient on temperature and solvent concentration has been determined from the experimental results. The simulations for a drying process of solvent cast films have been performed by using the expression of diffusion coefficient dependent on temperature and solvent concentration obtained from experiments under various drying conditions.

S02-416

Spherulite Orientation and Mechanical Properties of Fibrillation Resistant PP Tapes

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Monoaxially oriented polypropylene (PP) is used in the production of fibrillation resistant thin tapes, in high-volume applications as geotextiles, packaging and filtration media. CaCO3 is commonly used as anti-fibrillation filler for PP tapes. However, no systematic study has been reported to understand correlations of processing conditions and filler content to spherulitic orientation and crystallinity; and consequently to mechanical properties. In this work, we demonstrate effect of stretch ratio and filler content on the performance of fibrillation resistant tapes. To aid this, development of an FT-IR based method employing principles of IR dichroism is demonstrated. From this method, Hermann's orientation factor in stretch and transverse directions for both crystalline and amorphous components, as well as crystallinity index (CI) could be quickly evaluated. Four sets of samples with 0, 5, 10 and 15 weight percentage of CaCO3 at three stretching ratios of 4.6, 5.1 and 5.5 were studied and compared to unstretched films. Orientation parameters Px, Py, Pz in the three directions for unstretched sample were comparable, each about 0.33, indicating equiaxial spherulitic morphology. Stretching of tapes resulted in remarkably higher values of Px upto 0.6, with proportional decrease in Py and Pz, pointing to formation of ellipsoidal spherulitic morphology in stretch direction. Increase in filler content from 0 to 15% resulted in methodical reduction of Px. In addition, CI was seen to steadily increase with increase in stretch ratios at constant filler content, and decreased with increase in CaCO3 at a particular stretching ratio. These effects of spherulite orientation and CI on mechanical properties were analyzed in detail and were also verified by polarized light microscopy and x-ray techniques. Detailed explorations of structure property correlations were carried out and resulted in good understanding of role of filler content and stretch ratio in tape performance

S02-487

An Attempt at Measurement of Winding Density Distribution in the Wound Roll of Plastic Film by Ultrasonic Wave Method

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Plastics film products are used in a lot of fields including packaging materials of food and industrial products and components of optical devices such as flat panel displays and electronic devices such as a flexible printed circuit. Film products are dealt with as wound rolls with a wide width of several hundred millimeters or more in many cases, and there are many reports about the winding technology of wide roll products. On the other hand, the plastic film products used for packing of electronic devices, a semiconductor and so on have a width as narrow as several millimeters, which are called a micro slit film. Therefore, a sophisticated winding technology is required for micro slit products as compared with wide wound rolls products. Few papers have been reported on the winding technology of micro slit films. Since micro slit products have a narrow width, they tend to be greatly influenced by outside environments such as temperature, humidity and vibration during winding, transport and storage. When the micro slit product receives in the environmental impact, the winding quality of the products becomes worse, including the warpage, shift and collapse of wound roll and the slack in the film. In order to evaluate the amount of air-entrainment exerting a great influence on winding quality, a ultrasonic wave method is applied to the measurement of winding density distribution in the wound roll.

S02-543

The Effect of Orientation on the Thermal Behavior of Nylon 6 Fibres

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Nylon 6 fibers like other synthetic fibers often undergo a thermal treatment intended for purposes such as reduction or elimination of residual stresses, enhancing dimensional stability, improvement of physical properties in some process such as texturizing, dying, and etc. In this paper, the thermal behaviour of nylon 6 with different degree of orientation has been studied by Thermo Mechanical Analysis (TMA) and Differential Scanning Calorimetry (DSC). The TMA results show that all samples have an abrupt extension before Tg. This elongation for NOY fibre is higher than that of POY and FOY fibres because of no orientation. NOY fiber has no shrinkage, and the length of fibre remained unchanged in the region of 60-90ºC, and after that increases with temperature increase. POY fiber shrinks before Tg (48-60ºC) and has dimensional stability in the region of 78-148ºC, which is important for textile processing .The dimensional stability region for FOY fiber (54-69ºC) is smaller than that of POY 's because of greater degree of orientation. The DSC thermograms of NOY, POY, and FOY fibres reveal three endotherms. The middle endotherm peak in NOY fibre is wider than that of POY and FOY fibres. This peak for POY fibres becomes narrower and smaller than that of FOY fibres. This peak almost disappear in FOY thermogram because of enhancement the perfection of small crystallites and orientation in FOY fibres.(Keywords: thermal behaviour, NOY, POY, FOY, Nylon 6, orientation, TMA, and DSC)

S02-568

THE EFFECT OF FEEDRATE ON MORPHOLOGY AND DEPOSITION AREA OF ELECTROSPUN NYLON 6 NANOFIBER

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Nylon 6 nanofiber has been produced using electrospinning process from nylon/formic acid solutions. The effect of feedrate as an important parameter on the morphology of electrospun Nylon 6 nanofiber has been investigated in this paper. Fiber diameter distribution as a result of increasing feedrate was also studied. The morphology of resulting nanofibers was observed and analyzed by using scanning electron microscopy (SEM). With increasing feedrate, pendant droplet volume at the needle tip is increased and more droplets drop is occurred. In this case fiber average diameter is first increased but then decreased. In order to control the process, the effect of feedrate on deposition area was another amazing subject which has been evaluated. In order to reach that purpose, electrospinning process has been examined at different feedrates while other parameters were kept constant. As a result with increasing feedrate, deposition area was also increased and larger area was coated by nanofibers. The resulting nanofibers were produced by nylon 6/formic acid solution at 20wt% and 20 kv while its feedrate was varied in the range of 0.1-1.5 ml/hr.

S02-666

Development of flexible materials for photonic optical skins

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During the last decade, the development of smart flexible skins has attracted large attention for a variety of applications such as tactile sensors. In the present work, we report on the development of flexible polymethacrylate-based copolymers which will be applied for the embedding of optical fibres, waveguides and data processing units. The chemical structure of the selected monomers is shown in the figure below.FIG 1: to be insertedA variety of copolymers were synthesised by varying the selected comonomers and the comonomer ratios. NMR spectroscopy revealed that there was a good correlation between the theoretical and the experimental composition of the copolymers developed (see table 1).TABLE 1: to be insertedThermal studies using DSC measurements indicated that the glass transition temperature (Tg) could be substantially lowered by partial replacement of the MMA by BuMA. The effect was even more pronounced when EHMA was used (see table 1). A lowering of the Tg leads to materials which possess a higher flexibility.At present, the copolymers are screened for two different applications. First, by combining the copolymers with Truemode™ (a material which is often applied for waveguide development and embedding), we want to develop materials which possess similar optical properties as Truemode™ but with a higher flexibility. Secondly, these materials will be used for the embedding of optical fibres. To test the embedding capacities of the materials, a UV transparent glass mould was fabricated by ultrasonic milling. Fibre alignment tools were produced by micromilling in stainless steel. The preliminary results indicate that this class of polymers represents an ideal class of materials for fine-tuning the properties of existing materials as well as for embedding optical fibres.This work is supported by the IWT-flanders as a part of the SBO project FAOS (Flexible Artificial Optical Skin)

S02-676

Effects of Rubbing PI Layer with a Velvet Cloth Composed of Surface-hydrolyzed Cellulose Acetate Fibers on the PI Alignment and Electro-optical Properties of LC Cell

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The conventional method to gain uniform liquid crystal (LC) alignment during the liquid crystal display (LCD) panel production is a rubbing the polyimide (PI) alignment layer with a velvet fabric composed of rayon, nylon or cotton. Although rayon velvet fabric has been generally used as a rubbing cloth for LC alignment, it is not stiff enough to endure repeated rubbings. In this study, surface-hydrolyzed cellulose acetate (CA) fiber was used as a pile fiber for the rubbing fabric to overcome the problem. The surface-hydrolyzed CA fibers were prepared by treating CA fibers in aqueous alkaline solutions of various concentrations. SEM, FT-IR, and WAXD analysis indicated that the resultant fibers had a sheath-core structure with a sheath component of regenerated cellulose and a core of non-hydrolyzed CA. In order to test its suitability for the rubbing process, the PI-coated glass substrate was rubbed with the velvet fabric composed of the surface-hydrolyzed CA fibers of various degrees of hydrolysis. The anisotropy of PI alignment layer was analyzed with photoelastic modulator and polarized FT-IR. The anisotropy was found to increase as the degree of hydrolysis of CA fiber was increased. The surface morphology of the PI alignment layer before and after rubbing was observed with an AFM. The roughness of PI alignment layer rubbed with the CA cloth decreased with the increased degree of hydrolysis. The characteristics of the LC alignment such as LC texture, pretilt angle, and electro-optical properties were also investigated.

S02-688

The use of corona discharge plasma treatment to improve adhesive properties of low density polyethylene to obtain laminates with polyolefin foam for uses in automotive industry

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Laminates based on a film-film or a film-foam structure find a wide variety of applications in technological sectors like automotive industry, as they are characterized by excellent balanced properties: mechanical, chemical inertness, good and wide surface finishing including soft tact. In order to obtain laminates, polymer films need some surface treatments for increase their low adhesive properties, because many polymeric films offer very low surface energy values (lower than 30 mJ•m-2). To solve this problem, some surface treatments (chemical, thermal, electrical) have been used in the last decades. One of the most interesting treatments is that based on plasma technology because it is an environmental friendly technology and promotes high surface energy values and, consequently, improve adhesive properties. At industrial level, corona discharge plasma technology finds important applications because it promotes surface activation. In this work, we have used corona discharge plasma technology to modify wettability properties of a low density polyethylene and make it useful for laminates with other films or foams. We have evaluated the influence of the working power and a complete study of the plasma-acting mechanisms has been carried out. Furthermore, since these laminates are to be used in technological applications, we have studied the influence of the temperature and relative humidity on the mechanical properties of the adhesion joints.The results show that working powers in the 600 W range are the most appropriate for low density polyethylene.

S02-694

NEW PLASMA TREATMENTS FOR IMPROVED DURABLE WETTING PROPERTIES OF NON-WOVEN POLYPROPYLENE TEXTILE SUBSTRATES FOR USES IN HYGIENIC APPLICATIONS.

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Polypropylene nonwoven fabrics are commonly used in products related with hygienic applications such as disposable absorbent articles, such as diapers, feminine care products, wipes. These applications need in many cases good adhesive properties and high wettability; however PP is a strong hydrophobic polymer. With the aim of improve the hydrophilicity of polypropylene, low pressure plasma treatment has been widely used as a surface polymer modifier technique, since it allows the application of plasma at relatively low temperature and a remarkable improvement of surface activation is obtained without affecting the intrinsic bulk properties of the material. The activation/functionalization of the surface is obtained by several ways in function of the used gas and the processing condition. By this way, the activation is obtained by inserting active species, surface abrasion or cross-linking processes. Surface modifications with plasma treatment have been studied for textile materials since the plasma treatment is environmentally friendly and reduce wet chemical and energy consumption. On the other hand, the effect of plasma containing an organic monomer as methane is known as plasmapolymerization. In this process, the monomer molecules in the plasma are activated and deposited on the surface material. In this study, hydrophobic nonwoven polypropylene was treated with methane-oxygen gas plasma activation and subsequent plasmapolymerization to modify its surface hydrophilicity. The gas methane-oxygen ratio used was 80:20. The effect of the variation of the plasma treatment conditions has been studied in order to optimize the plasma treatment. The film wettability has been analyzed by the study of the variation of the contact angle and free surface energy calculation. The nonwoven surface topography was analyzed by scanning electron microscopy (SEM).

S02-754

CHEMICAL PHYSICAL CHARACTERIZATION OF COMPOSITES BASED ON CHITOSAN AND CELLULOSE FIBERS

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Chitosan is a cationic carbohydrate biopolymer derived from chitin, the second abundant polysaccharides present in nature after the cellulose. The main sources of chitin are the shell wastes of shrimps, lobsters and crabs. Upon the removal of most of the acetyl groups from chitin by treatment with strong alkali, chitosan yields. So chitosan may be considered as a family of linear binary copolymers of (1→4)-linked 2-acetamido-2-deoxy-β-D-glucopyranose (GlcNAc) and 2-amino-2-deoxy- β-D-glucopyranose (GlcN). Due to the abundance, low cost and good chemical and biological properties, chitosan is widely used in medicine, nutrition, cosmetics, papermaking and several other application fields. Regarding to the chemical nature, chitosan and cellulose have similar structure, with the same b-glycosidic linkages, being the main difference the presence of primary amino groups at most of the C-2 positions in chitosan, in place of the hydroxyl groups of cellulose. Taking into account the importance of the two constituents, chitosan–cellulose fibers blends have been performed in order to have simultaneously, the chemical functionality of chitosan and the good mechanical properties of cellulose. In order to improve the mechanical performances of the blends, polyglycerol as plasticizer have been added, and the blends thus obtained have been tested throughout thermal analyses (DSC, TGA and DMTA) and tensile tests. Thermal analyses suggested evidence of some chitosan-cellulose interactions, mainly in the interfacial region between the small domains of both the polymers. Mechanical analyses evidenced the improvement of chitosan performances due to the presence both of cellulose and of plasticizer.

S02-862

THE ROLE OF THERMAL STRESSES IN THE REDUCTION OF THE GLASS TRANSITION TEMPERATURE OF THIN POLYMER FILMS.

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Finite scale affects the glass transition temperature of amorphous polymer. In particular, thin (thickness of the order of the radius of gyration) and ultrathin (thickness lower than the half of the radius of gyration) films of atactic polystyrene PS (the standard polymer used in these studies) have shown significant glass transition temperature depression (up to 70K). Phenomenum has been qualitatively correlated to the existence of enhanced surface dynamics in the polymer. In fact the glass transition temperature reduction of freely standing films doubles in respect to supported films of the same thickness. Afterwards, it is proven that the enhanced mobility of the layer at the surface of the PS films, which is liquid-like, persists in films that are up to 65 K below their corresponding bulk Tg. At the moment it is not clear how such findings can be quantitatively correlated to the glass transition reduction.The observed Tg reductions could be accounted for by a decoupling of the temperature dependence of the properties of the surface layer and the bulk polymer. Infact, cooling the sample below Tg(bulk) would result in vitrification of the bulk of the sample, but the surface would continue to behave as if it has a temperature near Tg(bulk). In this work we address the possibility that thermal stresses induced by the cooling of such bilayer material system could induce yielding of the polymer and consequently the experimentally observed glass transition temperature reduction.

S02-904

Effect of the Mixed solvent on electrospun polypropylene fibers

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Electrospinning was the process that produces continuous polymer fibers with diameter in the sub-micron range through the action of an external electric field imposed on a polymer solution. Polypropylene (PP) nanofibers were fabricated by the co-electrospinning technique. In this work, the effects of solvents and their properties on electro-spinnability of the as-prepared polypropylene solutions and the morphological appearance of the obtained PP fibers were investigated qualitatively by means of scanning electron microscope (SEM).In the electrospinning process of polymer solution, solvents were one of the main contributors for solution properties, e.g. solubility, viscosity, conductivity, and so on.Toluene was the solvent to dissolve PP pellets at room temperature, while N, N-dimethylformamide(DMF) was not able to dissolve PP pellets at the room temperature. Only the PP solutions in toluene, DMF were not spinnable, while PP solutions in mixed solvents of Toluene and DMF could produce PP fibers by electrospinning. A mixed solvent in Toluene and DMF has successfully used in the electrospinning process of polypropylene. When DMF was added to Toluene to attain the mixed solvent systems, the diameters of the electrospun PP fibers became bigger and the beaded fibers earlier were disappeared. The reason was claimed to increase in viscosity and conductivity of the mixed solvent, respectively.Based on the results observed, the values of the dipole moment of the solvent and the conductivity of the resulting solutions were very important factors determining the electrospinning the electro-spinnability of the solutions.

S02-907

Characterization of PP/PPG Nonwoven web by Elelctrospinning

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Electrospinning was the process by which sub-micron polymer fibers can be produced using an electrostatically driven jet of the polymer solution. Electrospun fibers are interesting in a wide variety of application including semi-permeable membranes, filters, composite applications and scaffolding for tissue engineering. Polypropylene(PP) was the engineering plastic polymer which was widely used as the material of filter or membrane, while it has limitation on use of hydrophilic materials because of its hydrophobicity. Therefore, the process of sulphuric acid, treatment of Plasma or Corora was tried to improve the hydrophilicity of PP polymers. This research tried to produce nonwoven web of PP polymer solutions with PPG concentration which was a hydrophilic material to increase hydrophilicity of PP by electrospinning. The nonwoven web was made by 12.5 % PP polymer solution with 1~3% PPG addition in the mixed solvent of toluene and N, N-dimethylformamide(DMF).The Nonwoven web was characterized by scanning electron microscopy (SEM) and universal testing machine (UTM). In particular, the hydrophilicity, especially the capacity of water absorption and the speed of water absorption of the nonwoven web, was investigated according to test methods for nonwoven (KS K ISO 9073-6).

S02-947

Effect of Gel Spinning and Drawing Conditions on the Properties of Poly(vinyl alcohol) Fibers

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Poly(vinyl alcohol)(PVA) fiber is widely used for industrial applications because of its unique characteristics such as bio-compatibilty, eco-friendliness, alkaline resistance, and high strength. For the application in the heavy-duty fibrous materials, PVA fiber spinning has been studied extensively to improve its mechanical properties. The methods of enhancing the mechanical properties of PVA fibers include using of high molecular-weight polymer and applying of low-temperature gel spinning. To get a high-strength and high-modulus PVA fiber, PVA/dimethyl sulfoxide(DMSO)/water system was developed by Cha et al. In this study, we examined the effect of various factors such as dope concentration, air gap gauge,coagulation temperature, and drawing and heat treatment conditions on the properties of PVA fibers prepared by low-temperature gel spinning method. We used the high molecular-weight PVA/DMSO/water system for the dope of gel spinning. Some structural parameter and physical properties of the spun-drawn filaments were evaluated with relation to the preparing conditions. With some optimum processing codition, we could get the extraordinary strong PVA fibers.

S02-1019

Effect of Intrinsic Viscosity and some of Spinning Conditions on Physical Properties of Poly(p-Phenylene Terephthalamide)

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kevlar aramid fibers were produced as an industrial fiber in 1972 by Dupont company. Kevlar fiber is a high strength, high modulus, high heat resistant material that is usefull in a wide range of applications. At this research work, first of all, ability of wet spinning and dry-jet wet spinning of Kevlar polymer with various molecular weight are investigated. For this purpose concentrated solutions of Kevlar polymer (with intrinsic viscosity of 1-5dl/g) in (H_2SO_4 100%) were prepared and spun. Some properties of produced fibers including mechanical properties, electron microscope observations, for instance tenacity & elongation of filaments were increased with increasing take up velocity. X ray diffraction, were studied.Finally in order to improve the properties of fibers, some spinning conditions were changed and effects of them on mechanicale properties of produced fibers were investigated.

S02-1258

Plasma polymerized acetylene films treated by helium plasma immersion ion implantation

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This work presents an investigation about the influence of ion implantation on amorphous hydrogenate carbon films. Thin films were synthesized by Plasma Enhanced Chemical Vapor Deposition (PECVD) from low pressure acetylene and argon mixture, using a 13.56 MHz radiofrequency (RF) discharge. Plasma Immersion Ion Implantation (PIII) was employed as post-treatment technique, using a helium plasma and high voltage negative pulses at different exposition times, ranging from 900 to 7200 s. X-ray Photoelectron Spectroscopy (XPS)were used to investigate the molecular chemical structure of the samples, using carbon peak (C 1s) at 284.6 eV as reference. Nanoindentation technique was employed to evaluate the mechanical properties of the film surfaces, such as hardness, stiffness and elastic modulus. Polymer film wettability was investigated by measuring of contact angle between a water drop and the sample surface. Surface energy of the films was obtained by the contact angle measurements using an apolar and polar liquid, diiodimethane and water, respectively. XPS spectroscopy revealed that treated samples are predominantly composed by sp2 carbon hybridization, however the proportion of sp3 hybridization slightly increased with the treatment time. The hardness of the films improved from 0.8 to 2.5 GPa, the contact angle dropped from 65º to 25º, and the surface energy increased from 56 to 74 erg, as the implantation time increased. These results are attributed to the growth of insaturation and crosslinking degree promoted by ion bombardment.

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Plasma polymerized hexamethyldisilazane treated by argon ion implantation

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Plasma processing is an effective technique to grow thin films from the hexamethyldisilazane (HMDSN) vapor, resulting in polymeric solids with amorphous and strongly linked chains. Therefore, their chemical and physical properties can be gradually changed by varying the process parameters, such as discharge type, power, pressure, reactive gas, deposition time, etc. Afterwards other treatments can be used to tailor their properties and, among them, Plasma Immersion Ion Implantation (PIII) has been studied. In this technique, ions created in the plasma are accelerated to the samples biased at high voltage negative pulses, and the energy dissipation on the polymer surface causes alterations in its properties. This paper describes the effect promoted by argon PIII into plasma polymerized hexamethyldisilazane films. Deposition plasmas were excited by 13.56 MHz radiofrequency (RF) source, using an input power of 100 W and pressure of 40 mTorr. Ion implantation was accomplished in argon RF discharge, using pulse amplitude of -10 kV and repetition rate of 100 Hz, power of 80 W and pressure of 40 mTorr. Infrared (IR) and visible ultraviolet (UV) spectroscopes were employed to analyse the molecular chemical structure and the refractive index of the samples. Hardness of the films was determinate by nanoindentation technique. IR spectroscopy revealed that 3000, 2350, 1650, 1250 and 1010 cm-1 bonds stretching were influenced by thetreatment time. Refractive index varied from 1.86 to 2.00, and the hardness improved from 1.0 to 3.0 GPa, as the implantation time increased from 15 to 60 min.

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Encapsulation of nanohybrids into Polycaprolactone by electrospinning.

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The present work reports, for the first time, the successful fabrication of Layered Double Hydroxide (Mg-Al LDH) reinforced polycaprolactone (PCL) nanofibers by electrospinning. Either the LDH in carbonate form or an LDH organically modified with 12-hydroxydodecanoic acid (LDH-HA) were incorporated into PCL and electrospun using a voltage of 20 KV. The LDH-HA was prepared by ionic exchange reaction from pristine LDH and encapsulated into PCL from acetone solutions at 15 wt%. The morphological analysis showed for pure PCL fibers with an average diameter of 600 ± 50 nm, and this dimension was maintained in the fibers with LDH, with the inorganic component residing outside the fibers and not exfoliated. At variance the fibers with the LDH-HA showed significantly lower average diameter in the range 350 ± 50 nm, indicating improved electrospinnability of PCL. Moreover the inorganic lamellae were exfoliated, as shown by X-rays and residing inside the nanofibers as demonstrated by Energy Dispersive X-ray Spectroscopy analysis (EDX). The structural parameters, as degradation temperature and crystallinity were investigated for all the samples and correlated with the electrospinning process.