Optical and structural properties of thermally treated iPP fibers: Effect of strain rate

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Abstract

Two-beam polarizing interference (Pluta) microscope was used to study the effect of annealing conditions (temperature and duration) and strain rate on the physical properties of isotactic polypropylene (iPP) fibers. The percentage shrinkage of the fiber length at different annealing conditions was studied. The effect of strain rate on the birefringence and molecular orientation of stretched iPP fibers was carried out before and after annealing. The test samples of iPP fibers were treated at two annealing temperatures: 80 degrees C and 120 degrees C and four durations: 0.5, 1.0, 1.5, 2.0 and 4.0 h. Empirical formulae were suggested for correlating the fiber birefringence, the molecular orientation factor, and strain rate at three different stretching speeds; 038, 0.57, and 0.77 cm/s. Upon stretching at constant temperature, it is found that the stretching speed has the main effect of controlling the alignment of the polymeric chains in the tested fiber. Birefringence profiles were determined for iPP fibers at different stretching speeds. The average values of maximum (observable) birefringence for iPP fibers were calculated and found to be 0.042, 0.027 and 0.026 for untreated and annealed samples at temperatures of 80 degrees C and 120 degrees C, respectively.

Language: English

Author Keywords: Polypropylene fiber; Birefringence; Stretching speed; Annealing

KeyWords Plus: ISOTACTIC POLYPROPYLENE FILMS; MOLECULAR-WEIGHT DISTRIBUTION; MECHANICAL-PROPERTIES; NECKING DEFORMATION; BIREFRINGENCE; POLY(ETHYLENE-TEREPHTHALATE); MICROSTRUCTURE; ORIENTATION; MORPHOLOGY; PATTERNS

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Influence of wavelength and temperature on the optical and some structural properties of polyester and polyamide surgical suture fibers

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Abstract

The present article studies the optical properties dependent on wavelength and temperature for polyester PET and polyamide PA surgical suture fibers by interferometry. The polarizing Pluta interference microscope was used to investigate the changes of the optical and structural properties at different wavelengths and temperatures. The resulting data were utilized to calculate the spectral dispersions and some structural properties such as Cauchy's dispersion constants, the resonant wavelength, the oscillation energy, the dispersion energy, the optical permittivity and the dielectric susceptibility for PET and PA sutures with different wavelengths at room temperatures. Relationship between the optical parameters with different temperatures at constant wavelength of PET and PA suture fibers were given. The variation of refractive index, isotropic refractive index and birefringence profile were measured at different temperatures.

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KeyWords Plus: INTERFERENCE MICROSCOPE; BEHAVIOR

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Opto-thermo-mechanical Characterization for Polyester and Polyamide Surgical Sutures

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Abstract

This work studies the opto-thermo-mechanical properties of two different surgical sutures using interferometry. The polarizing Pluta interference microscope combined with opto-thermo-mechanical (OTM) device were used to study the effect of drawing on monofilament polyester (PET) and polyamide (PA) surgical sutures at room temperature. The variation of the refractive indices and the birefringence of both PET and PA sutures with different draw ratios were determined. The resulting data was used to calculate the optical orientation function and the average work per chain. The stress strain curve was studied to estimate some mechanical parameters; yield stress, yield strain, Young's modulus and strain optical coefficient. The variations of the refractive the index profile were calculated for different draw ratios. In addition we studied the effect of temperature, during the drawing process, on monofilament PET suture. The obtained results provide important data for better characterization of suture materials.

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Online double-arm of a multiple-beam Fizeau system: I. Optical setup for simultaneous recording of two interferometric patterns in the same frame

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Abstract

An online optical setup for simultaneous recording of two interferometric patterns with two different colours in the same frame on the basis of a multiple-beam Fizeau system is designed. This setup allows measuring of refractive indices (n(perpendicular to) and n(parallel to)) for the two directions of the light vibration, for one sample of the fibre, simultaneously from a single captured frame. These simultaneous measurements enable one to obtain accurate determination of the birefringence (Delta n = n(parallel to) - n(perpendicular to)) for the tested sample. Software developed for the digital processing of the patterns is used for automatic digital fringe analysis. The novel optical setup is used for the online investigation of PP fibres under creep deformation for duration t = 1000 s, followed by a relaxation process for duration t = 4000 s. Optical parameters for the material of the tested fibre are studied interferometrically using the novel setup. Microinterferograms and graphs are given for illustration.

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Author Keywords: Optical; Microscopy; Interference

KeyWords Plus: REFRACTIVE-INDEX MEASUREMENT; FABRY-PEROT-INTERFEROMETER; FIBER

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On-line opto-viscoelastic analysis of polypropylene fibres using multiple-beam Fizeau fringes in transmission and a modified creep device

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Abstract

A creep device attached to an automated multiple-beam Fizeau system in transmission was modified with a designed digital ruler. This device allows on-line measurements of fibre length during creep experiments in terms of an analogue voltage value. The influence of sustained stress values on creep deformation and optical properties (n(parallel to), n(perpendicular to) and Delta n) for polypropylene (PP) fibres was studied interferometrically. The opto-viscoelastic properties of PP fibres were determined for three different values of constant applied stress of 11.536, 18.717 and 25.905 MPa, at room temperature. Also, the variations of the cross-sectional area and Poisson's ratio were studied during creep extensions. The compliance curves were obtained as a function of both time and applied stresses. Empirical formulae are suggested to describe the creep compliance curves for PP fibres, and the constants of these formulae were determined and described at each applied stress. A Kelvin chain was used to model the mechanical behaviour of the PP fibres under study. The effect of strain on the mean refractive indices, orientation function density and crystallinity was investigated as a result of the recorded data. Microinterferograms are given for illustration. The modified creep device with the designed digital ruler enables one to obtain instantaneous automatic accurate recording of fibre length values during creep experiments. Calculation of refractive indices, orientation function and crystallinity shows a difference in material behavior at small stresses from that at higher stresses which may be attributed to different strain rates caused by different stresses. (C) 2010 Society of Chemical Industry

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