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Article / Book Information

題目(和文)	二軸配向高分子フィルムのレーザー穿孔における加工－構造－特性の関係
Title(English)	Processing-Structure-Property Relationship in Laser Perforation of Biaxially Oriented Polymer Films
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学位種別(和文)	博士論文
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種別(和文)	要約
Type(English)	Outline

Dissertation outline

In Chapter 1, the general introduction of this thesis was given.

In Chapter 2, fundamental laser perforation behavior of the PP films prepared by simultaneous equi-biaxial stretching was discussed. The BOPP films equi-biaxially stretched to various stretching ratios were produced. The detailed analyses on the laser perforation behavior and the formations of a circular hole and a rim surrounding the hole through the laser-beam irradiation was conducted by changing the focal length of the lens for focusing the laser beam on the film surface and also the laser fluence. The width and height of the deposited rim surrounding microholes and depth of crater were evaluated. The volume losses or materials removal were also investigated. In-situ observation of microhole formation was observed by the high-speed video.

In Chapter 3, laser perforation behavior of the PP films prepared by sequential and simultaneous biaxial stretching of various MD and TD stretch ratios were evaluated. The BOPP films with various stretching ratio were prepared. The molecular chain orientations of BOPP films from biaxial stretching process were investigated by birefringence measurement. For laser perforation, the relation between the film structure and the laser perforation behavior was investigated. The microhole shape was found to be affected by molecular chain orientations. The comparison of simultaneous and sequential biaxial stretching process were also discussed.

In Chapter 4, laser perforation behavior on the PLA films prepared by simultaneous biaxial stretching was investigated. The BOPLA films with various stretching ratio were prepared. When the laser was applied on the PLA film, the microhole formation of PLA film was observed. The effect of annealing process applied to the film was also studied. Moreover, the microhole formation behaviors of PLA and PP films were also compared.

In Chapter 5, theoretical estimations of the temperature distribution along the film thickness and along the radial distance from the center of the laser irradiation as well as the analysis on the variation of radial temperature distribution with time caused by the thermal conduction were studied. Moreover, the relation between the theoretically estimated temperature and experimental results were also discussed.

In Chapter 6, the gas permeability of laser perforated PLA films of various biaxial stretch ratios was determined by the static method. The effect of film thickness, a number of microholes and the influence of the shape of microhole on gas permeability were investigated.

In Chapter 7, summary of this dissertation was given.