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An Attempt to Simulate the Optical Axes on Film during Tentering Process in Successive Biaxial Stretching Method

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Nowadays, wide and flat homogeneous films are required to satisfy quality of large-size liquid crystal displays. Tentering process in successive biaxial stretching method is one of the most important processes to form retardation on optical films. Thus, analysis of the mechanism of tentering process is required. Analysis to predict thickness distributions and bowing phenomenon during tentering process has been performed by finite element analysis (FEA). In our knowledge, the calculation methods involve important optical properties which depend on the molecular orientation, for example optical axes and retardation are not established yet. The formula for the molecular orientation is not included in the conventional FEA calculation. Therefore, the orientation prediction is difficult to calculate by FEA only. This study shows a new calculation method to predict optical axes of stretching films basis on elastic-plastic FEA calculation. Especially polymer relaxation process is concerned. FEA and optical property calculation are independent in the methods. Stress relaxation calculation is performed after FEA calculation. Comparatively good correlation between the calculated and experimental results was obtained for optical axes under the constant temperature. This method enables to calculate optical axes of films during tentering process easily by use of FEA calculated results obtained under various temperatures by considering the temperature-dependence of material properties. From the results, the following conclusions were obtained. The optical axis is tilted in MD slightly with movement from center to edge of the film. Due to increase of temperature in the stretching zone, slant to MD of optical axis become low and influence by stress relaxation is low too. The quantitative prediction of optical axis needs to consider stress relaxation.