

MOLECULAR ORIENTATIONS OF NEMATIC LIQUID CRYSTALS IN BAR COATING PROCESS.

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Although spin coating is the most popular method used to form a polymeric thin film for various electronic devices, its use is very limited for applications in large area samples. We formed thin liquid crystal(LC) films using a bar coating method and studied LC orientation changes in the film prepared by this coating method. In the present study, photo-curable liquid crystalline di-acrylate (BASF LC242) which shows a nematic mesophase between 80 ~ 120 °C was used. The nematic LC was bar-coated at various temperatures and then cured to a thin film by UV exposure. The orientation of LC molecules in the film was investigated using polarized FTIR spectroscopy and a birefringence measurement. We found that LC molecules in the film are oriented in a normal direction to the bar coating direction when coated near crystallization temperature while oriented along the coating direction with increasing coating temperature. It is known for liquid crystal polymers that LC flows show various shear induced orientation mode, i.e., the LC director tumbling (rotational) at low shear rate, wagging (oscillatory) at intermediate shear rates, and alingning (stationary) modes at high shear rates. To understand such effects in the thin film coating process of nematic liquid crystals, we investigated effects of coating conditions, such as coating speed, film thickness, and temperature, on LC molecular orientations in the film. The effect of bar coating conditions on LC orientations was studied for nematic liquid crystalline di-acrylate using polarized FTIR spectroscopy. It is quite surprising that LC molecules align perpendicular to the coating direction during a bar coating process, that is, the LC orientation direction is normal to a shear flow direction at slow coating speed or low coating temperature. LC molecules are aligned perpendicular to the flow direction at a low coating speed and change the orientation direction to parallel with increasing coating speed as shown in Figure 1 where the order parameter S changes its sign from negative to positive with the bar coating rate. Using ATR-FTIR spectroscopic technique, it was also found that LC molecules near the top layer are inclined to orient parallel to the coating direction whereas perpendicular at the bottom layer.

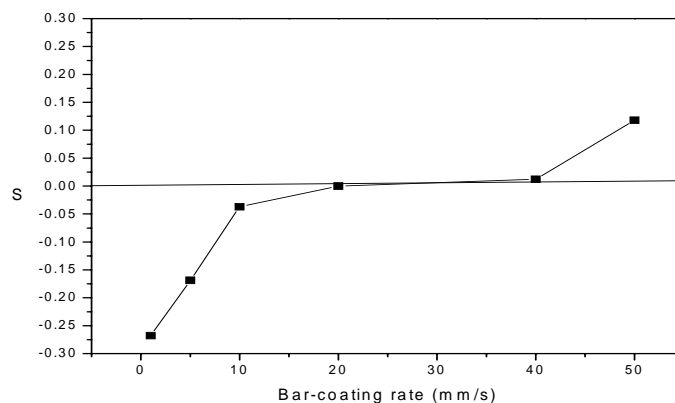


Figure 1. Order parameter of liquid crystal molecules in the film bar-coated at various coating speed.