ESRF

Experiment title:

Kinetics of crystallisation in polyethylene terephthalate subjected to rapid draw around the glass transition

Experiment number:

SC-120

Beamline:

ID13

Date of Experiment:

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Shifts:

Local contact(s):

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Report:

Understanding the mechanism of strain induced crystallisation in polymers is important for industrial polymer processing. Strain induced crystallisation enables high orientation to be obtained by preventing chain slippage. It also stabilises orientation after draw and prevents shrinkage above T_g.

In the present study, we have investigated the strain induced crystallisation of PET as a function of draw ratio, draw rate and draw temperature. Samples were drawn at 80, 85,90, 95, 100, l10 and 120°C with nominal draw ratio of 3.6:l. The draw rates were 9000% per minute and 72000% per minute. In each experiment a series of 124 diffraction patterns were recorded using a Photonic Science CCD camera linked to an i860 based Synoptics frame grabber with an exposure time of 40 msec. These diffraction patterns were recorded with essentially no dead time between them. A selection of diffraction patterns for a 9000% rein-l draw for temperatures 80, 85, 90, 95, 100, 110 and 120°C is shown in figure 1. A selection of diffraction patterns for 72000% min^{-1} for temperatures 80, 85, 90, 95, 100, 110, 120 and

125°C is shown in figure 2.

It is clear from figure 1 and figure 2, that the degree of crystallisation finally achieved and the rate at which crystallisation develops depends on the draw temperature and the draw rate. From the data collected in this study it can be seen that at lower draw rates and higher temperatures, relaxation of the polymer chain is the dominant factor but at higher draw rates, relaxation has much less effect. A particularly important conclusion is that in all cases evidence of crystallisation is observed after the draw is completed. This data allows the kinetics of crystallisation to be analysed from measurements on the increase in intensity of characteristic diffraction peaks. These results can be approximated by an exponential growth curve and the data is currently being analysed to determine the dependence of the rate constant on the draw parameters.

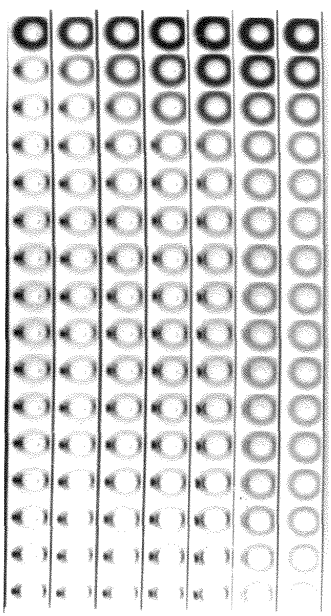

Figure 1

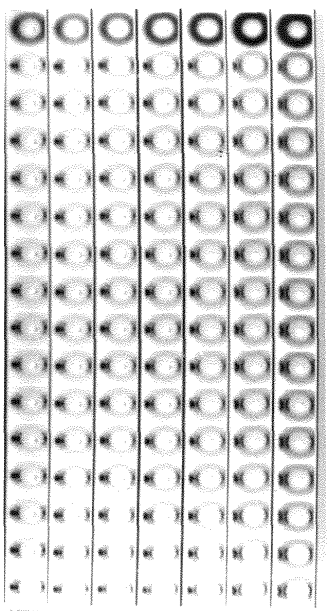

Figure 2