



Experiment title: Investigation of strain-induced crystallization kinetics during biaxial deformation of PET under industrial processing conditions.

Experiment number:
SC-662

Beamline: ID02A	Date of experiment: from: 14/06/00 to: 17/06/00	Date of report: 27/02/01
Shifts: 9	Local contact(s): Dr. Volker Urban	<i>Received at ESRF:</i>

Names and affiliations of applicants (* indicates experimentalists):

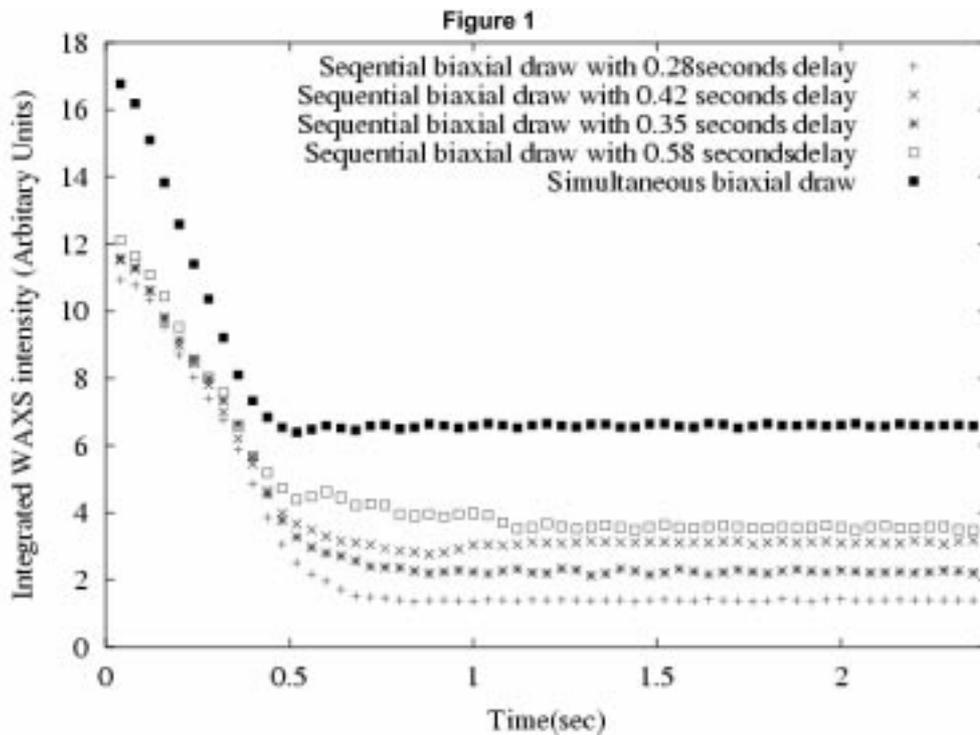
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Report:

In this study we have recorded time-resolved simultaneous WAXS and strain data during the biaxial deformation of polyethylene terephthalate (PET) using a modification of the Keele uniaxial drawing camera which incorporates four rather than two stepper motors. The modified camera allows samples to be drawn biaxially either simultaneously or sequentially with varying delay time between the draws in each direction. In this report we describe the results obtained during simultaneous and sequential biaxial draw with various delay times of a PET sample at a nominal draw rate of $72000\% \text{ min}^{-1}$ and at 90°C upto a nominal draw ratio of 3.5:1. Diffraction data and strain data was recorded using a CCD camera with 40 milliseconds time resolution. Sample thinning at the point where the diffraction pattern was recorded was monitored by computing the total integrated intensity of the wide angle x-ray scattering (WAXS) pattern and shown in figure 1. It can be seen from figure 1 that the sample thinning rate for simultaneous draw is much faster than for the sequential draw. It can be seen that the effectiveness of the second draw in the sequential draw clearly depends on

the delay time between the two draws. If the delay time is small such that the end of first draw coincides with the start of the second draw, with no time to crystallise after the end of first draw, the network is able to respond without hinderence from crystals.



The diffraction data was analysed using the analytical techniques developed at Keele to isolate the crystalline component of the diffraction data in these type of experiments. Figure 2a and 2b show the crystalline component

extracted from the last frame (124) of simultaneous biaxial deformation (figure 2a) and sequential biaxial deformation (figure 2b) with 0.28 seconds delay time. The final level of orientation and crystallinity are comparable in both cases. However with increasing delay time of the second draw beyond 0.28 seconds, an increasing amount of reorganisation is taking place in the crystalline part of the structure. This can be clearly seen from figure 1 where as the delay time increases, the apparent thinning during the second draw decreases. Also preliminary analysis shows that the rate of crystallisation during biaxial drawing with equal strain along the two axis is much similar to uniaxial drawing for the same draw ratio.

