ESRF	**Experiment title:** The structure development during the constant force deformation of polymer materials	**Experiment number**: SC-1155
Beamline: ID02	**Date of experiment**: from: 25/06/03 to: 28/06/03	**Date of report**: 29/02/04
Shifts: 9	**Local contact(s)**: Dr. T. Narayanan	*Received at ESRF:*

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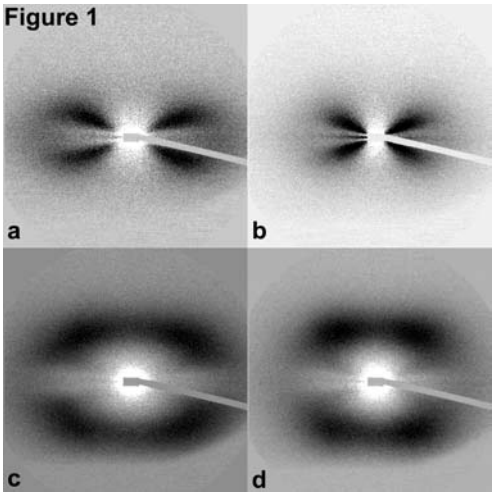
Report:

In this study we have recorded simultaneously SAXS/WAXS/Strain developed/Force applied during uniaxial deformation of polyethylene terepthalate (PET) at constant velocity and constant force using the Keele drawing camera. The camera allows samples to be drawn uniaxially and to be thermally annealed at elevated temperatures with an accuracy of 1.0^{o}C. In this report we describe the results obtained during uniaxial deformation of PET at temperatures 90 ^{o}C, 100 ^{o}C, 110 ^{o}C and 120 ^{o}C at draw rates from 2250% min^{-1} to 18000% min^{-1}. SAXS/WAXS data was recorded simultaneously using a two dimensional SAXS CCD detector and a two dimensional WAXS CCD detector with 0.01 seconds exposure time with 0.12 second interval between exposures. A selection of SAXS patterns recorded during deformation of a PET sample at 120 ^{o}C is shown in figure 1. Figure 1a and 1b are at the end of



deformation for PET samples drawn at 18000% min^{-1} and 2250 min^{-1} respectively. Following the end of deformation, the sample is annealed at the draw temperature. The SAXS patterns recorded from the annealed specimens are in figure 1c (18000% min^{-1}) and figure 1d (2250 min^{-1}). The cross type of SAXS patterns (Figure 1a and Figure 1b) suggest that the initial structure produced by drawing consists of tilted lamellaes. The angle of tilt increases with draw rate for a given draw temperature. This can be seen in figure 1a (18000% min^{-1}) and figure 1b (2250% min^{-1}). This feature is retained on the four-point patterns (Figure 1c and 1d) In a furthur study the SAXS pattern recorded from a PET sample sample drawn at 90 ^{o}C with constant force of 7N (Figure 2a), 8N (Figure 2b), 9N (Figure 2c) and 10N (Figure 2d) force are shown in figure 2. These SAXS patterns shows a gradual small increase in the tilt angle of the four-point SAXS pattern with respect to the draw direction with increasing force for a given draw temperature. Figure 3 shows the SAXS pattern taken from PET samples drawn at 90 ^{o}C (Figure 3a), 100 ^{o}C (Figure 3b) and 110 ^{o}C (Figure 3c) with a constant force. These SAXS patterns show a decrease in the tilt angle of the four-point SAXS pattern with respect to the draw direction with temperature for a given constant force. This study clearly demonstrates the link between the development of the structure and molecular organisation during strain induced crystallisation as a function of the force, draw rate and draw temperature.