ESRF	**Experiment title:** Investigation of strain-induced structural changes during uniaxial and biaxial deformation of polypropylene film under industrial processing conditions.	**Experiment number**: SC-782
Beamline: ID02A	**Date of experiment**: from: 27/06/01 to: 30/06/01	**Date of report**: 27/02/02
Shifts: 9	**Local contact(s)**: Dr. Volker Urban	*Received at ESRF:*
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Report:

In this study we have recorded time-resolved simultaneous WAXS and strain data during the uniaxial and biaxial deformation of polypropylene (PP) using the Keele drawing camera. The 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 simultaneous and seqential biaxial draw with various delay times of PP samples at a nominal draw rate of 72000% min^{-1} and at 155^{o}C up to a nominal draw ratio of 8:1. 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 moinitored by computing the total integrated intensity of the wide angle x-ray scattering (WAXS) pattern. We have deveopled an analytical techniques to analysize the whole WAXS two dimensional diffraction to determine the crystallinity index during deformation of a polymer sample in these experiments. Typical results from the above experiments using a novel analytical technique to separate the crystalline and amorphous components are shown in figure 1, where figure 1a

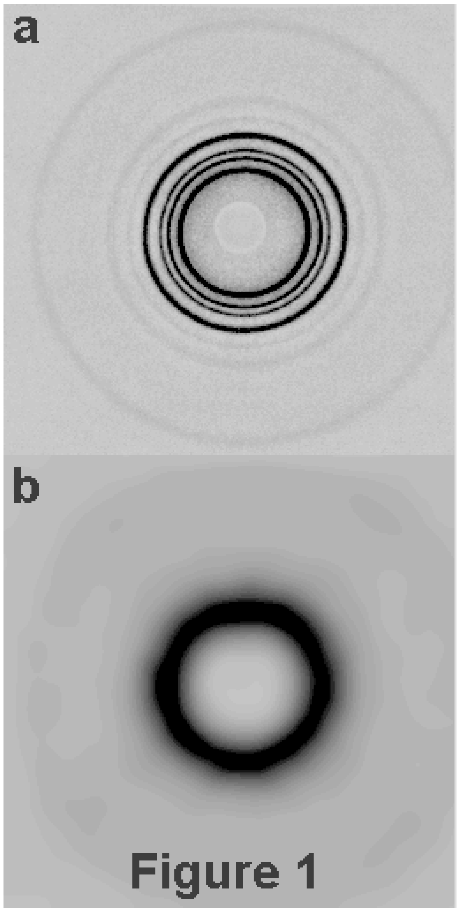
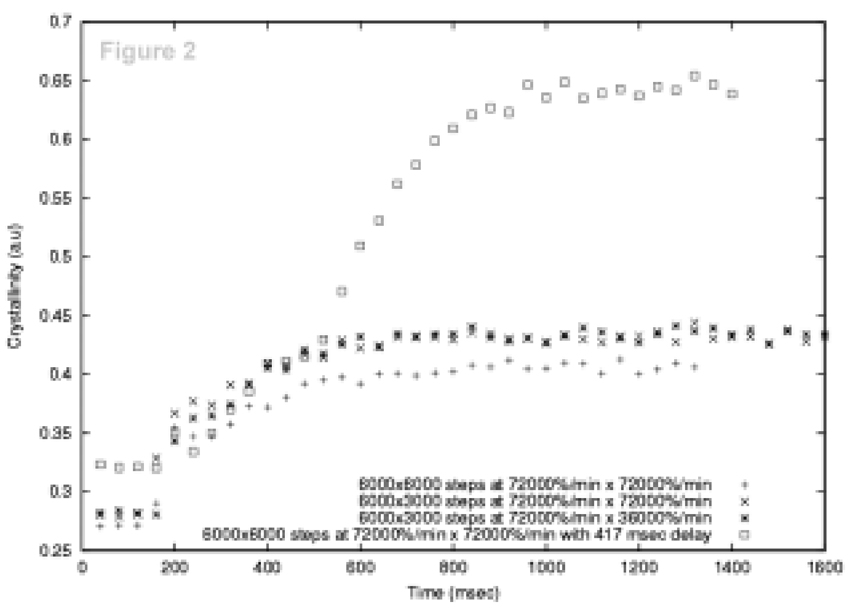


Figure 1

shows the initial crystalline component of the WAXS pattern and figure 1b shows the initial amorphous component of the WAXS pattern.

We have applied the above technique to determine the changes in crystallinity index during various biaxial drawing protocols. Some of the selected examples are:- (a) simultaneous equal biaxial draw at 72000%/min with 6000 steps on each axis, (b) simultaneous nonequal biaxial draw with nonequal draw time at 72000%/min with 6000 and 3000 steps on the two axes, (c) simultaneous nonequal biaxial draw with equal draw time at 72000%/min and 36000%/min with 6000 and 3000 steps on the two axes, (d) sequential equal biaxial draw at 72000%/min and 6000 steps on each axis with the delay of 417msec between drawing on the two axes.

The changes of the crystallinty index during the above deformation experiments are show in figure 2 with (a) (+), (b) (×), (c) (∗) and (d) (□). It can be seen from figure 2 that there is very little difference in the changes in crystallinity during the various simultaneous biaxial draws.



During the sequentail draw (□) up to the end of first draw (417 milliseconds) the changes in crystallinity index are similar to those on simultaneous biaxial draws. However, the subsequent second draw shows a 50% increase in the crystallinity index. This result has major implications for the design of protocols for commercial film production where the extent of crystallinty has important consequences for product properties.