ESRF	**Experiment title:** Time-resolved x-ray diffraction studies of simultaneous and sequential biaxial deformation of poly lactic acid under industrial processing conditions.	**Experiment number**: SC-2183
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Report:

We have recorded simultaneously SAXS/WAXS/Strain/Force Applied during biaxial deformation of poly lactic acid (PLA) using the Keele biaxial camera. In this report we describe the results obtained during simultaneous biaxial deformation of PLA samples 4032D (~1.5% D-isomer) and 4060D (~10% D-isomer) at 90 ^{o}C with the draw rate of 9000% min^{-1}. One of the major challenges involved in biaxial deformation studies is to determine suitable sample geometry for a given polymer sample. In the present study, we have succesfully adopted a modified version of a sample geomety which has been succesfully developed and used in the studies of poly ethylene terephthalate. A typical image of a simulateneously and equibiaxially deformed PLA sample at 90^{o}C with a draw rate of 9000 min^{-1} is shown in figure 1. Figure 1 shows that the centre part of the sample was

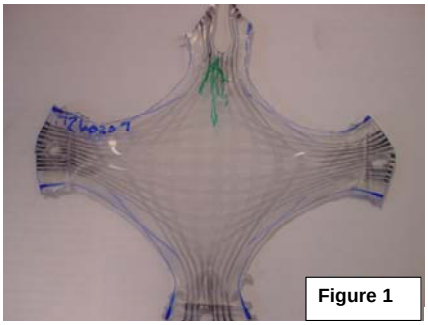
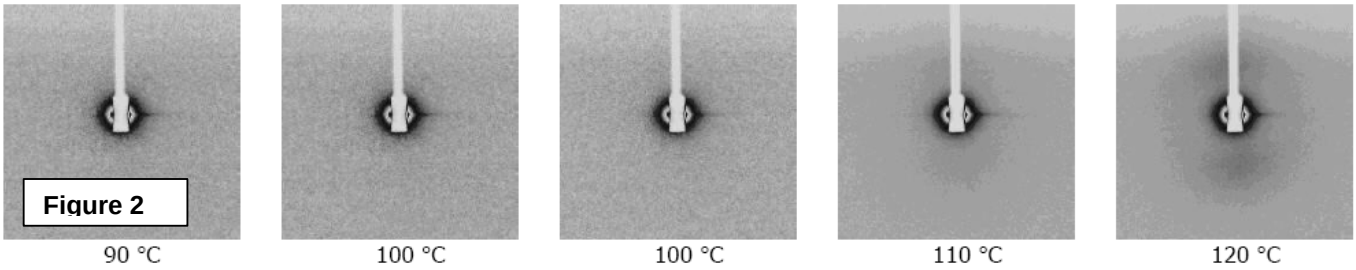
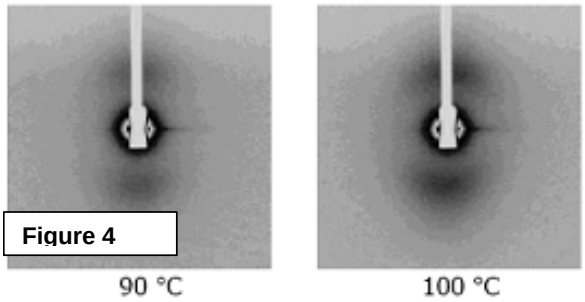


Figure 1

uniformly deformed where the SAXS/WAXS data was recorded. PLA sample 4032D was simultaneously and equibiaxially drawn at 90^{o}C with a draw rate of 9000min^{-1} and was



subsequently step annealed up to 120^{o}C. During the annealing process, simultaneous SAXS/WAXS data was recorded. A SAXS data is shown in figure 2 and the WAXS data for the final temperature (120^{o}C) is shown in figure 3. There is no evidence of SAXS pattern at the end of the draw and up to an annealing temperature of 100^{o}C (Figure 2). The SAXS pattern begins to develop ~110^{o}C.



SAXS data recorded during a similar biaxial deformation study of the PLA sample 4060D is shown in figure 4 and the WAXS data for the final annealing temperature (110^{o}C) is shown in figure 5. In our previous studies, under similar drawing conditions, crystallisation has been observed in a uniaxially drawn 4060D sample. Furthermore, unexpectedly the 4060D sample (biaxially drawn) shows a relative strong SAXS pattern at the end of draw and it further developed during the annealing process. This suggests a development of a two phase system while there is no evidence of crystallisation from the WAXS data (figure 5). These observations require further systematic investigations to identify the development of the structure/ morphology during the biaxial deformation of PLA as a function of amount of D-isomer in PLA samples.