ESRF	**Experiment title:** Temporally and spatially resolved simultaneous micro-SAXS and stress / strain measurements of single struts of an open-celled elastomeric polyurethane foam.	**Experiment number:** SC-643
Beamline: ID13	**Date of experiment:** from: 20.11.99 to: 23.11.99	**Date of report:** 29.02.00
Shifts: 9	**Local contact(s):** Dr. C.Riekel	*Received at ESRF:* 11 - MAR. 2000

Names and affiliations of applicants (* indicates experimentalists):

***Professor W.Fuller,** Department of Physics, Keele University, U.K.
***Dr G.Eeckhaut**, ICI Polyurethanes, Everberg, Belgium.
***Dr A.Mahendrasingam**, Department of Physics, Keele University, U.K.
***Mr C.Martin**, Department of Physics, Keele University, U.K.
***Dr D.J.Blundell**, ICI Research & Technology, Middlesbrough, U.K.

Report:

The aim of this proposal was to record simultaneously small angle X-ray scattering (SAXS), stress and strain during the micro deformation of single struts of an open-cell elastomeric polyurethane (PU) foam with cross-sectional dimensions of a few tens of microns and lengths of about 300 microns.

We have used a micro-SAXS experimental setup with a collimater and post aperture optimised to resolve d-spacing ~300A. The strut sample of ~250 micron length and ~70 micron diameter was mounted on a purpose built micro-strain device[1] using specially developed techniques which enable the sample to be mounted without introducing strain.

Strain to the sample was applied by applying a dc voltage to the micro-strain device. Force applied to the sample was measured by a calibrated force transducer. During the deformation a video image of the sample was recorded. Local strain on the sample was measured from these video images. SAXS diffraction data was recorded using a MAR-CCD detector with an exposure time of 15 seconds. During a typical experiment, the overall strain of the sample was increased to 1.4:1 with an interval of 30 seconds between each steps.

A preliminary analysis of this data is shown in figure 1. The insert in figure 1 shows the variation of the applied force on the sample as function of time. Frame numbers of selected frames are inserted in the curve to compare with the results from the SAXS data.

The d-spacing of the unstrained sample from the SAXS data is 220A. As applied stain on the sample increases there is a corresponding gradual increase in the SAXS d-spacing from frame 1 to frame 14. From figure 1, it can be seen even after the strain is reduced the sample appears to extend up to frame 17. When the applied strain of the sample is completely removed, the SAXS d-spacing and the peak intensity do not return their original values (frame 28). This indicate that the strain is not completely reversible and there is a degree of hysteresis in the straining process.

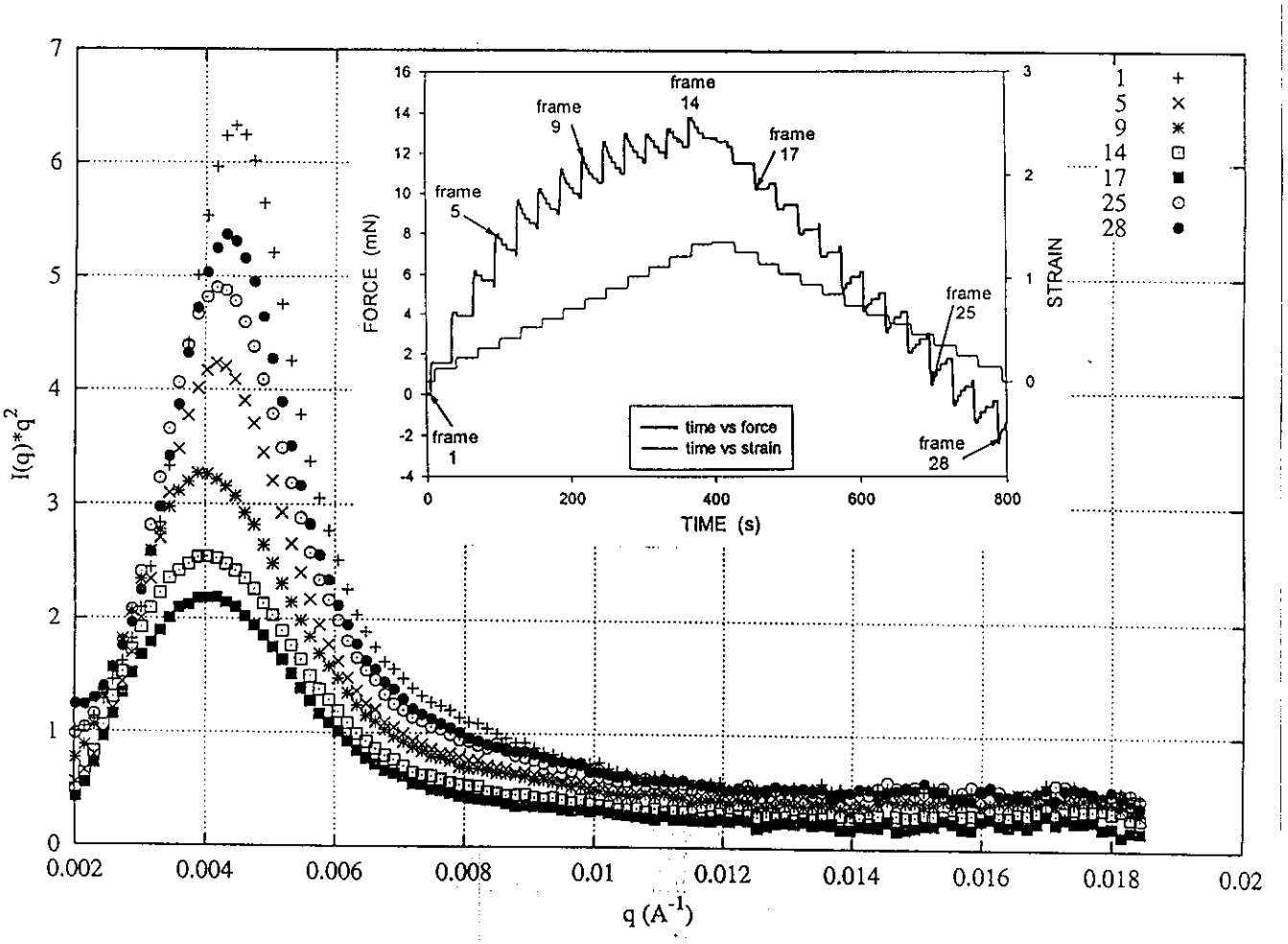

Figure 1: A selected sequence of radial scans of the SAXS pattern from a single strut of PU foam. Insert shows a corresponding force/time ans strain/time for single strut of PU foam.

Reference

1. *"Micro-SAXS and Stress / Strain Measurements During the Tensile Deformation of Single Struts od an Elastomeric Polyurethane Foam"* Martin C, Eeckhaut G, Mahendrasingam A, Blundell DJ, Fuller W, Oldman RJ, Bingham SJ, Cunningham A, Dieng T, Riekel C, *Journal of Synchrotron Radiation*, submitted.