ESRF	**Experiment title:** **Structure-Property Gradients in Coir Fibers**	**Experiment number**: SC-1888
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Report:

The mechanical performance of natural lignocellulosics and artificial cellulosics is closely related to the orientation of cellulose nanofibrils expressed ususally through the orientation factor $\cos^2\langle\phi\rangle$ or microfibril angle (MFA). The response of the tissues on external load depends on the initial orientation of the fibrils as well as on the specific stage of the tensile experiment. In our previous experiments [1-10], we have demonstrated how the orientation of cellulose fibrils changes upon straining and correlated those processes with the actual mechanical response of wood, coir and cellulose fibers in dry and wet conditions.

In the present experiment, the scanning across coir and cellulose fibers was performed in order to map the local orientation of fibrils using position resolved WAXS. In the original proposal, we have applied for the beamtime at ID13 and a beam at least 1µm in diameter. Finally, the experiments were performed at ID01 with the beam 5µm. We have characterized cellulose fibers produced using various spinning procedures and coir fibers with different diameters. The fibers were studied in the original conditions, during straining and bending. In order to strain the fibers, the users have delivered to the beamline an own tensile stage.

The experiments were very successful and provided a new insight into the nanostructure of the tissues. Below, just two examples (based on preliminary evaluation) are presented. A scanning across straight and bent coir fibers has provided an information how MFA changes in the fibers (Fig. 1). Interestingly, the tensile side of the bent fiber exhibits a relatively large MFA up to 67 degrees.

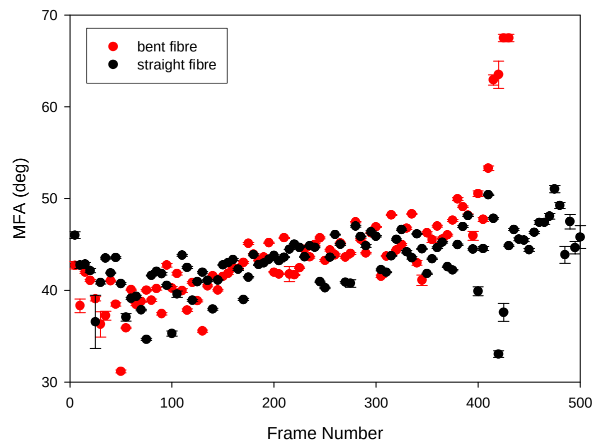

Figure 1 MFA across coir fibers was characterized by position resolved WAXS performed on a virgin fibre and on a bent fiber. The results left indicate that the MFA in the bent fiber increased significantly on the tension side while, on the compression side, no significant increase was observed.

Cellulose fibers produced using different spinning procedures were characterized position resolved (Fig. 2). The orientation factors differ significantly. The results were correlated with the mechanical experiments and document a very close structure-property relationship.

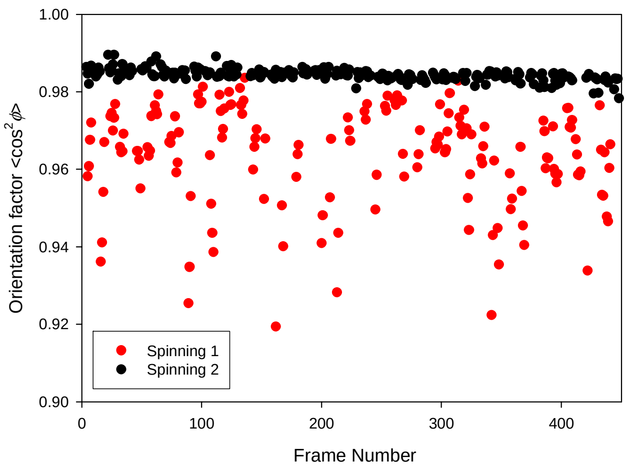

Figure 2 Orientation factors of two cellulose fibers characterized by WAXS scanning across the fibre. The average magnitude of the orientation factor differs significantly. The data correlate with the results of mechanical tests performed on the fibers.

In conclusion, the experiment was very successful and, after the thorough data evaluation, the users will present the results in referred journals.

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