SCANCO MEDICAL

3D Analysis of the internal structure of polyester tissue

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application note

Customer need

In this application the customer, a manufacturer of various types of artificial tissue, wanted insight in the structure of new type of polyester tissue (see Fig. 1)

An important requirement was to provide a detailed analysis of the micro architecture of the tissue. This meant that a nominal resolution in the order of magnitude of only a few µm had to be reached.

Furthermore the customer desired an objective, numerical characterization of the fibre structure.

Materials and methods

In order to accommodate the above mentioned requirements, the tissue was investigated using a Scanco Medical µCT 35 scanner. This specimen scanner is able to accommodate samples with a maximum diameter of 37 mm and a maximum length/height of 120 mm. The best achievable nominal resolution is 1.75 µm with an object of 7 mm diameter.

The following settings have been applied by means of an easy configurable measuring protocol:

-Nominal Resolution: 3 µm
-Beam energy: 45 kVp
-Beam Intensity: 178 µA
-Integration Time: 8 s
-Image Matrix: 2048x2048x23

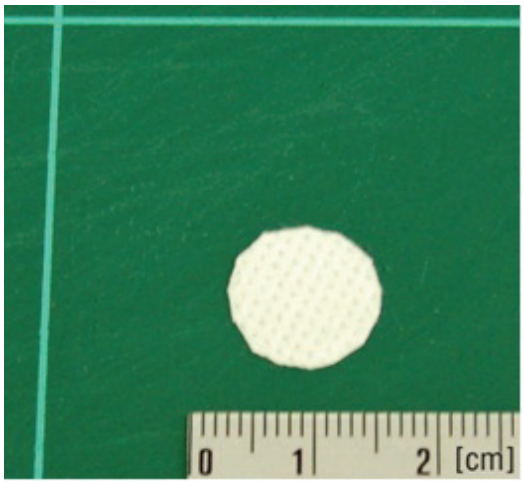

Figure 1: Picture of the tissue to be analysed

Customer need
Characterization of the micro-architecture of polyester tissue.

Materials and methods
SCANCO Medical µCT 35 scanner was used to produce the images and SCANCO evaluation software for segmentation and 3D morphometric analysis were used for the analysis.

Results
Qulitative: Visual evaluation of the homogeneity of the fibre structure.
Quantitative: Thickness of the fibres in the tissue.

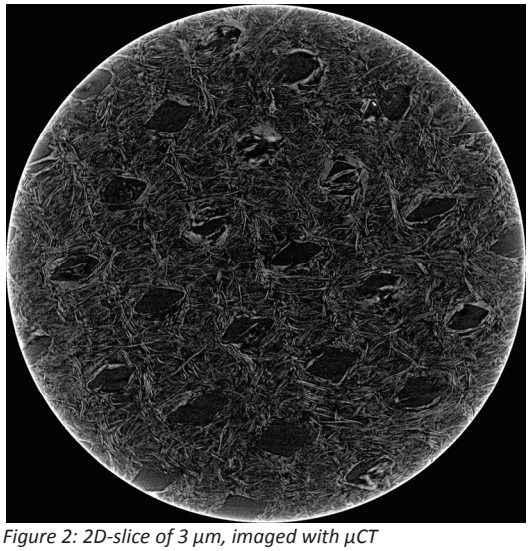
Figure 2: 2D-slice of 3 µm, imaged with µCT

As can be seen from Fig. 2 the individual fibres and their structure can already be recognized in the 2D-slice images.
In order to get a clear view on the homogeneity of the fibre structure, different virtual cuts of the 3D rendered image of the tissue were made. (see Fig. 3a,b,c,d)

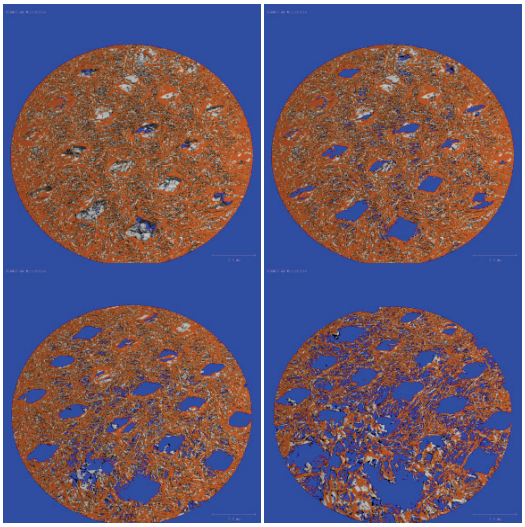

Figure 3a,b,c,d Series of virtual cuts of, showing the in-homogeneity.

The standard option to visualize cuts of the sample ad libitum proves to be a very valuable tool to study the homogeneity of the micro architecture.

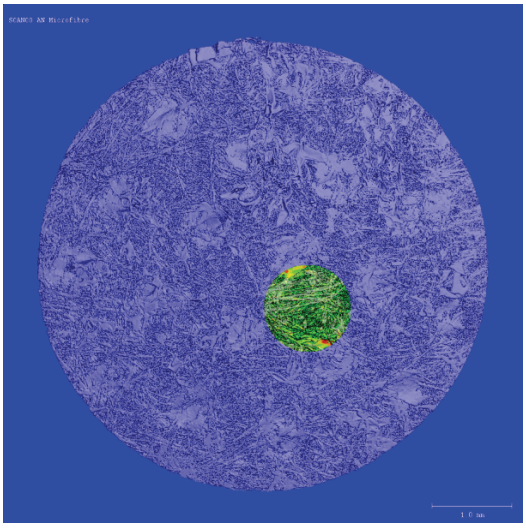

Figure 4: 3D view showing detail of the fibre structure, which was analyzed further.

Results of the analysis

In a next step a small circular part of the microfiber was chosen for more detailed analysis. (see Fig 4). By applying a standard evaluation script on this part, the thickness of the fibres in the polyester tissue can be calculated (see Fig. 5). These results are also available in numerical format (table or histogram).

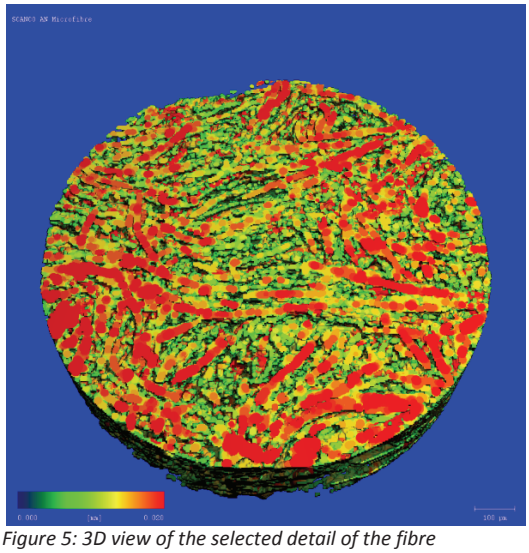

Figure 5: 3D view of the selected detail of the fibre structure, with fiber-thickness map.

Conclusion

Choosing this unique method provided the desired characterization of the tissue fibre structure in a consistent manner.

This method can be applied to many other materials. The only condition is, that the material must be transparent to x-rays with an energy of max. 90 kV.

References

Numerous references to similar studies can be found on the SCANCO Medical webpage: www.scanco.ch

SCANCO equipment
SCANCO Medical µCT 35 scanner

SCANCO software
Measurement program incl. Scout View
Evaluation program
- ✓ Segmentation
- ✓ 2D/3D morphometric analysis

Visualization program

application note