CONSTGLASS	
Technical Data sheet	UNIVERSITEIT GENT

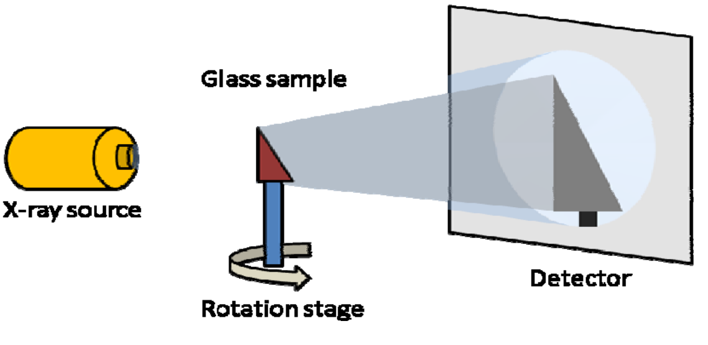
Technique :	High resolution X-ray computed tomography (µCT)

General description

In general, Computer Tomography (CT) investigates the external and internal structure of objects in 3D using any kind of penetrating radiation without actually opening or cutting the object. Without any form of sample preparation it is thus possible to obtain a 3D computer model of the sample. The technique has shown to be revolutionary in medical diagnostics since it has enabled doctors to visualize internal organs and bone structure with precision and with high safety for the patient. It soon became clear that X-ray CT (X-rays as penetrating radiation) had a large potential for numerous non-medical applications as the technique rapidly evolved and became widely accessible. Recently, X-ray tomography has become an important non-destructive research tool in other fields like cultural heritage as it allows detailed qualitative and quantitative research without destroying the (art and other valuable) objects under investigation.

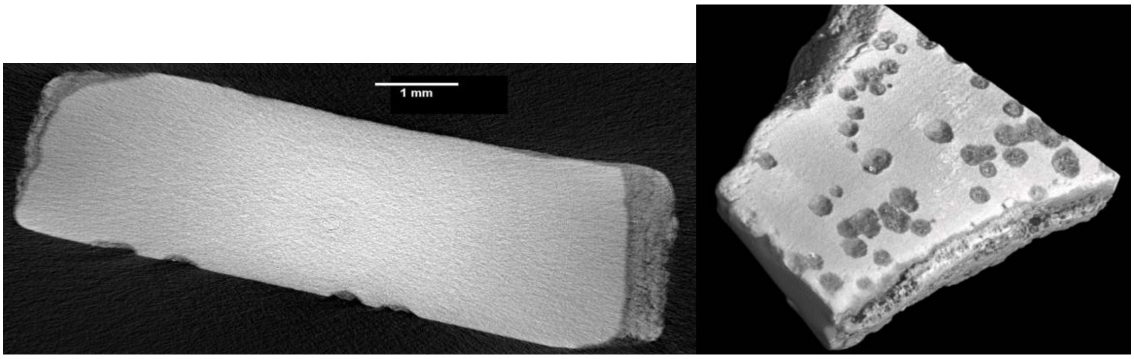
Operating principle

A high-resolution laboratorial X-ray micro CT scanner contains basically a fixed X-ray source, a rotational stage and a detector. Generally, the basic principles of high-resolution X-ray CT are the same as for medical CT. Sample rotation instead of source-detector rotation and resolution improvement are the most innovative adaptations. To perform CT, digital radiographs or shadow images of the sample are made from different orientations by rotating the sample along the scan axis from 0 to 360 degrees. In such a radiograph, the information of the sample is summed along the path of the X-ray beam. This radiograph can reveal certain information, but to obtain a full 3D image of the sample, it has to be illuminated from different angles. In practice, a number of projections roughly equal to the number of horizontal pixels is sufficient for a good acquisition. After collecting all the projection data, the reconstruction process is started, which produces horizontal cross-sections of the sample, allowing rendering 3D models. Materials like plastic, wood, polymers, and even denser objects like sediments, stone and glass can be easily studied with X-rays.



Centre for X-ray computed tomography at Ghent University

The X-ray tomographic scans for the CONSTGLASS project were performed at the Centre for X-ray Computed Tomography at Ghent University, Belgium (UGCT, www.ugct.ugent.be). The micro-CT scanner used for that purpose is a medium energy (up to 160 keV) scanner. The X-ray tube is an open type Feinfocus tube. The maximum power of the directional tube is 150 W. Typical scan time varies from 10 min up to 2 hours. The system's magnification, which increases with the specimen's proximity to the X-ray source, combines with the fixed pixel size of the X-ray detector to determine the limits of spatial resolution. To obtain very-high resolutions (in the order of several µm) with a cone beam configuration, very small samples (of a few mm) are required. More information about the equipment can be find on www.ugct.ugent.be.



These two figures show the reconstruction of a medieval blue glass with corrosion (left and right faces) and corrosion pits (bottom). The left image is a slice; the right image is a 3D image of the same sample. (Sample courtesy of DBV Cologne, sample n° med 2)