3D X-ray Micro-tomography

A table-top system, CT-Mini, is a micro-CT scanner with a small footprint for ***non-destructive*** study of solid material including plastics, ceramics and new materials. This computer tomography set-up (from Procon X-ray GmbH) provides convincing ***3-D CT images (walk-through the sample)*** in a few minutes. This space-saving CT-MINI can detect a flaw in micro-meter range (**14 microns, Shannon limit**). It consists of a microfocus X-ray tube (7 micron focal spot) and a Hamamatsu flat panel detector (1024x1024 photo-diodes). Maximum magnification can be achieved by changing the object to detector distance. Horizontally directed rays result in gravitational influence free CT scan. Transform based methods [1] have been used for reconstruction purpose and error estimates, based on tomographic filters [2, 3,4] of CT images, can also be made available to the users.

This scanner is ideal for non-destructive testing, materials evaluations and dimensional measurement especially in internal structures, rear-cut and free-form surfaces.

Main features of CT-MINI are as follows:

- Industrial X-ray computed tomography (CT)
- 3D volume CT
- Non-destructive testing- 2D and 3D
- Independent quality control of materials
- Defect detection
- Non-contact metrology
- CT reconstruction in almost real time
- Easy to use
- Radiation safety better than 1 mSv/h
- Desktop System

References:

[1] Jain N, Kalra M S, Munshi P, Characteristic signature of specimen using an approximate formula for 3D circular cone-beam tomography, Research in Nondestructive Evaluation, 22 (1991) pp 169-195.

[2] Munshi P, Rathore R K S, Sriram K, Kalra M S, Error estimates for tomographic inversion, Inverse problems, 7(1991), pp 399-408.

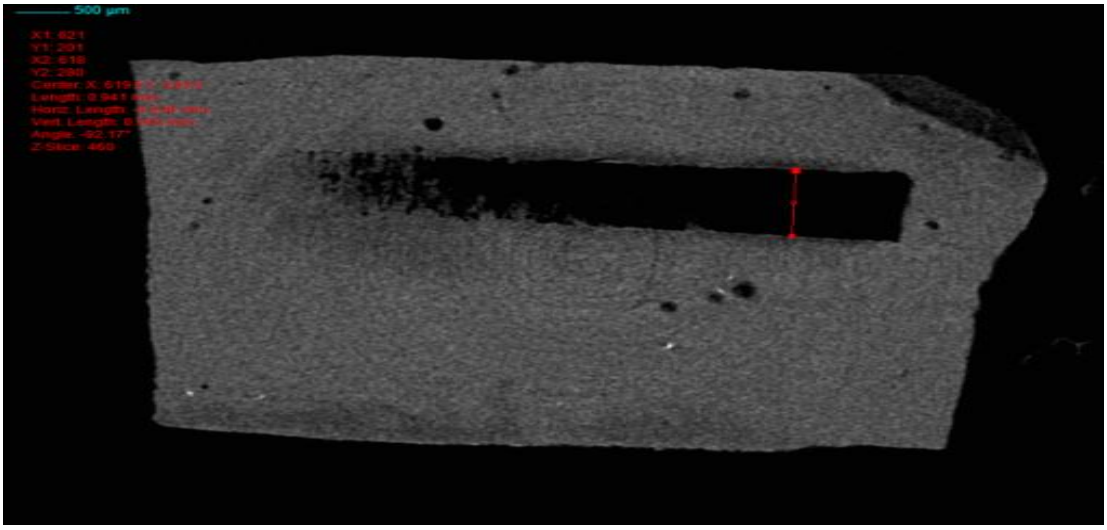
[3] Munshi P, Error Analysis of tomographic filters I: Theory, NDT & E International, 25(1992) pp 191-194.

[4] Munshi P, Maisl M, Reiter H, "Experimental aspects of the approximate error formula for computerized tomography", Materials Evaluation, 55(1997) pp 188-191.

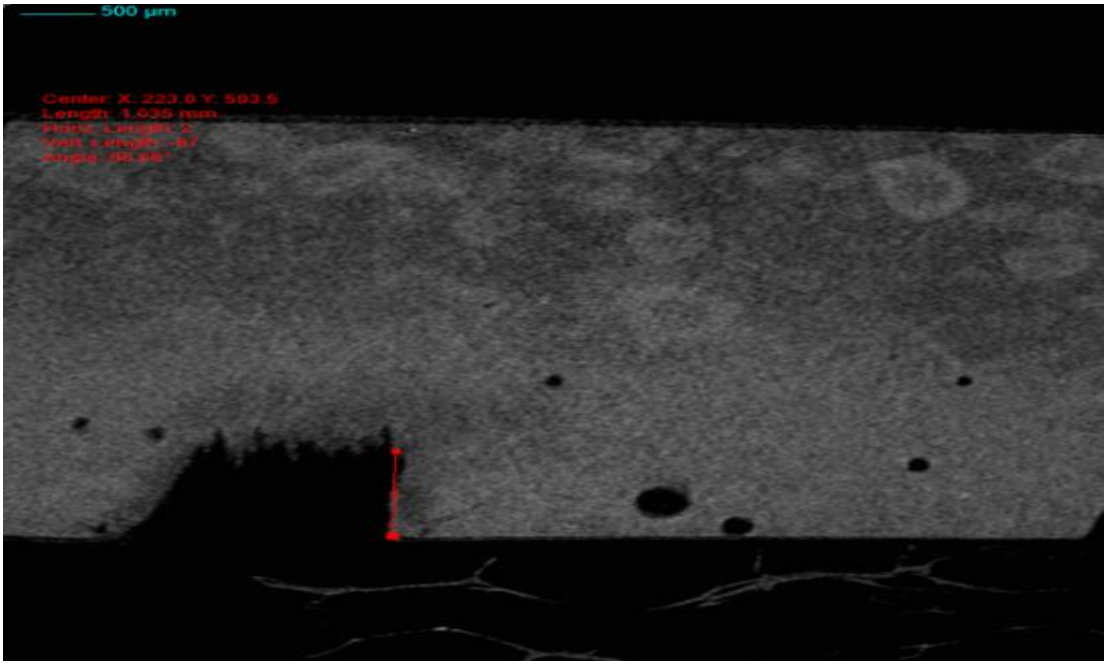
Results for three different test specimen are given below. They are of three different type, i.e., carbon composit te, Perspex and ceramic.

(A) Carbon composite:

Top View (Scale is visible on the top left corner of the image)



Front view:

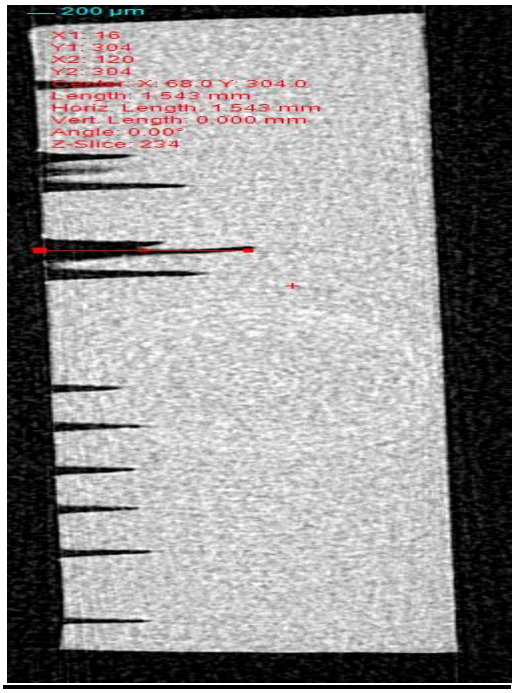


The objective of this study to know the dimension of the channel made on carbon composite and the deformation developed on the surface during manufacturing. A channel has been made using laser of 1 mm wide through the composite. It has been found in Computed Tomography (CT) study of this sample that the width of the channel is 0.941 mm which is

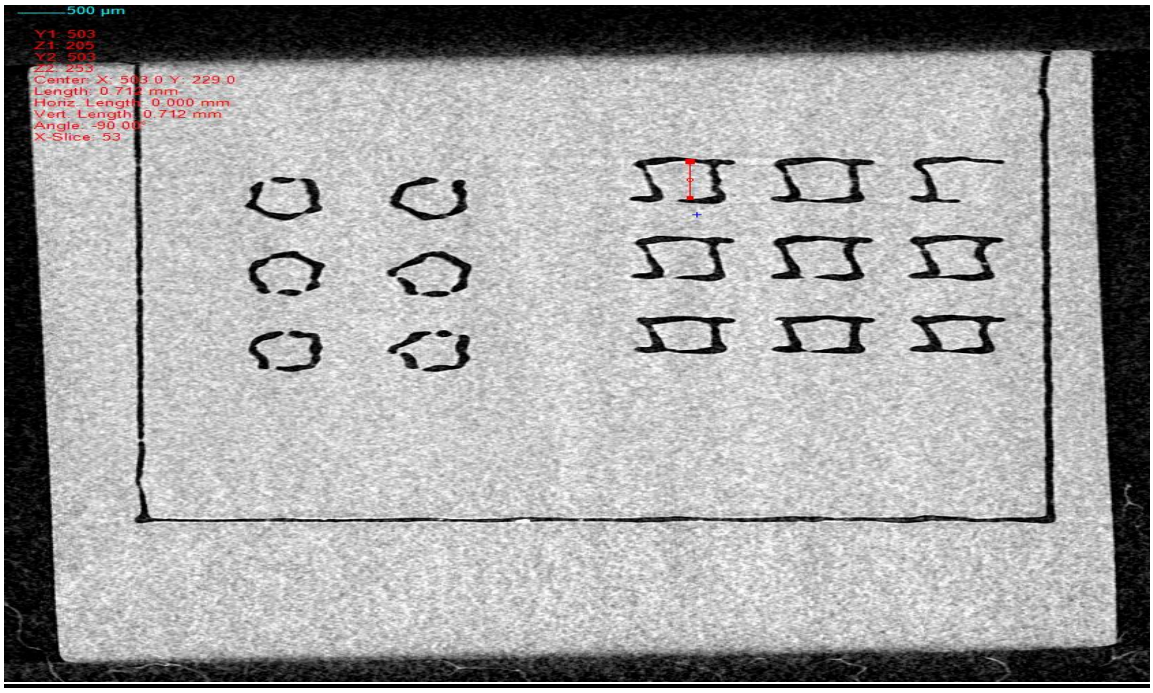
closer to 1 mm. It has also been found that the sample in not smooth. It has some porosity. The resolution achieved in this CT study is 11.89 micron.

(B) Perpex Sample (4I)

Top view:



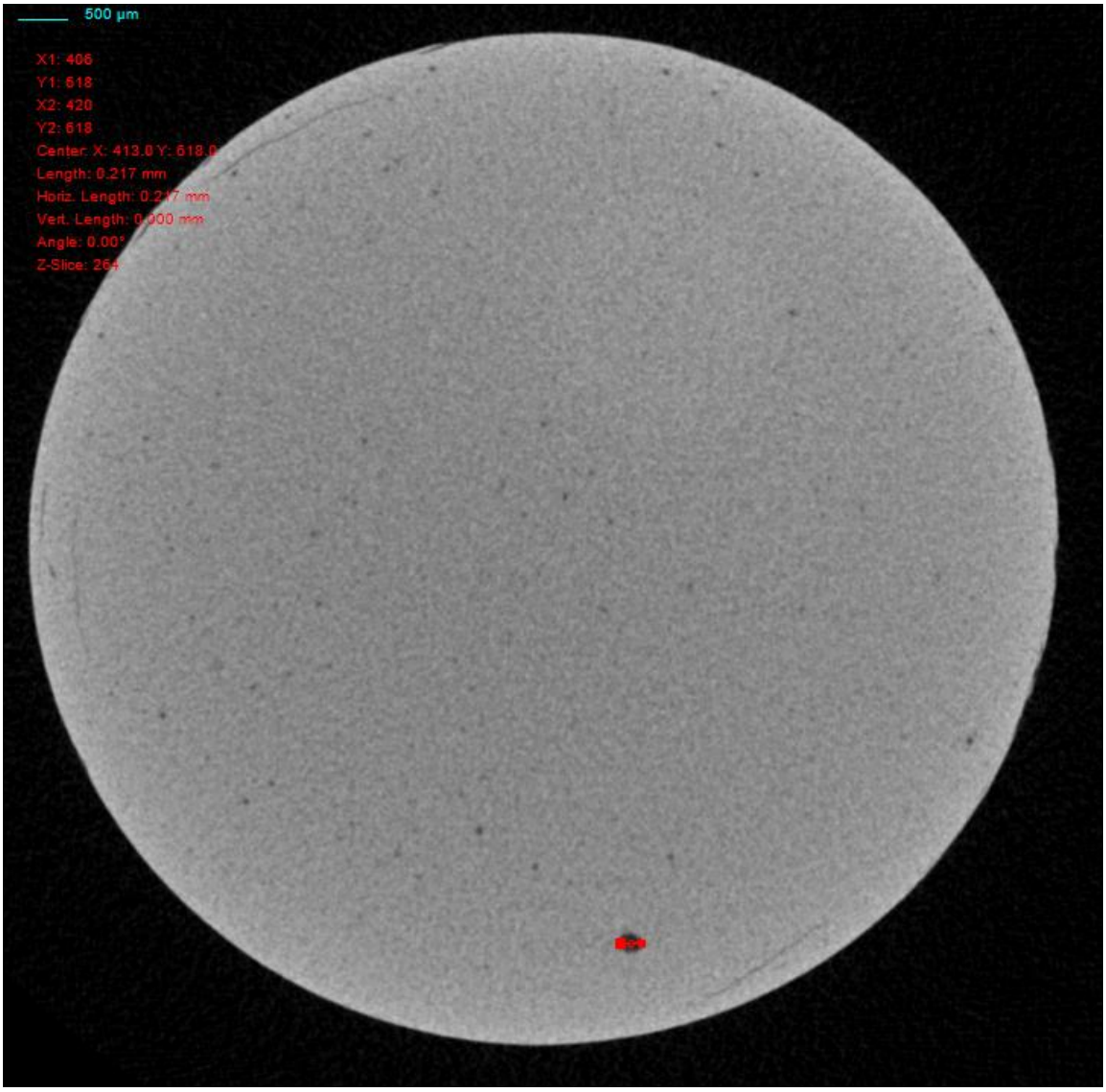
Front view:



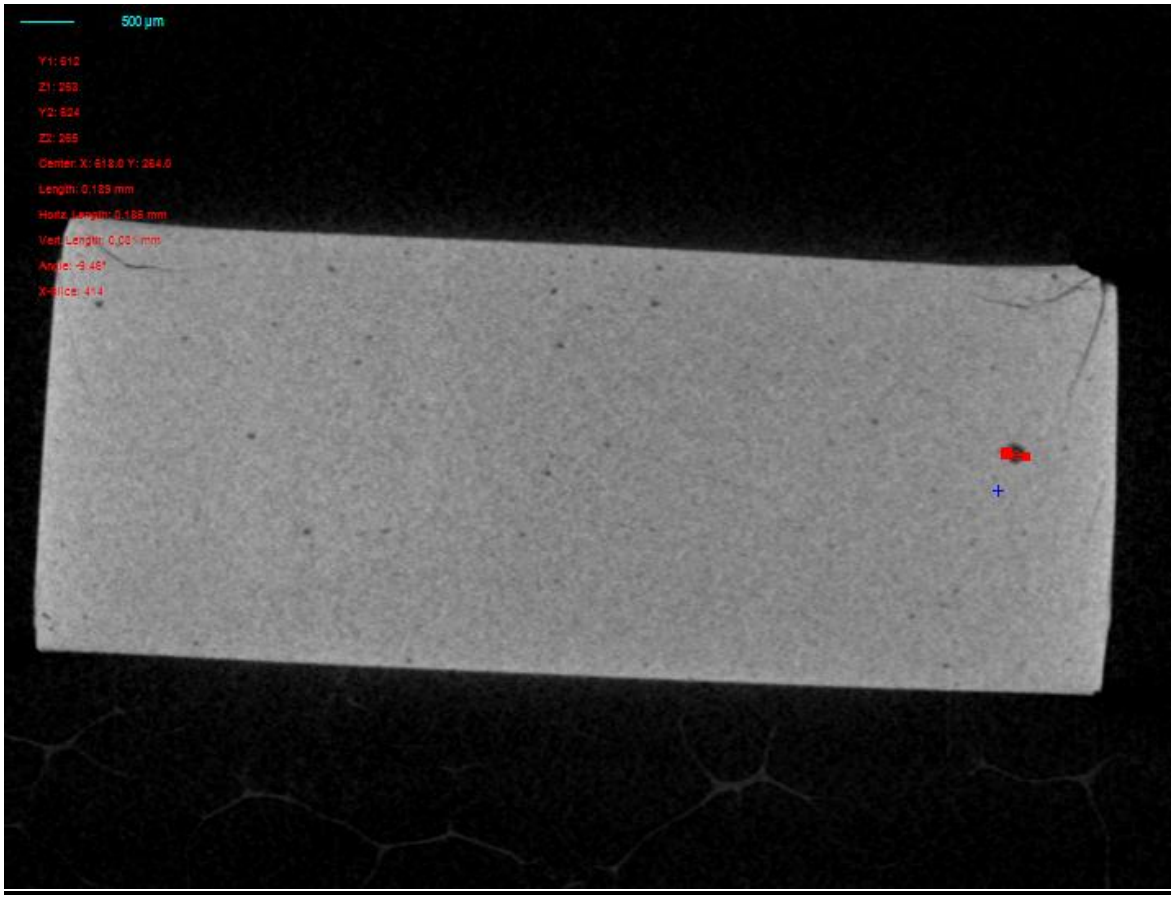
The aim of this study is to know the penetration depth obtained from a laser on a perpex sample for a fixed set of parameters. Some structures have been made on perpex sample using laser for fixed parameters. This manufacturing process should generate same depth structure on the surface of sample. It is clear from top view reconstructed image obtained by CT study that the depth is not same. The largest value is 1.543 mm as shown in top view. It has been also found that the rectangles made are not exactly rectangular in shape as shown in front view. The resolution achieved in this study is 14.83 micron.

(C) Ceramic:

Top view:



Front view:



The aim of this study was to know the internal structure of the ceramic and to know about any defect/ impurities inside it. It is visible from the reconstructed images of top and front view that the sample has some holes. The largest hole is of the diameter 0.217 mm. the resolution of these images is 15.49 micron. It also has some cracks.