Recent and Future Upgrades on Neutron Imaging Facility
DINGO at OPAL

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Summary: Recent upgrades to the neutron imaging facility DINGO to higher resolution close to 1µm driven by demand of the scientific and industrial user community.

1. INTRODUCTION

The neutron radiography / tomography / imaging instrument DINGO is operational since October 2014 to support research at ANSTO [1]. DINGO had a high subscription rate from a broad national and international scientific user community and for routine quality control for defense, industrial, cultural heritage and archaeology applications. DINGO provides a useful tool to give a different insight into objects because of different contrast compared to X-rays and high sensitivity to light elements. In the field of industrial application it has shown promising results for studying cracking and defects in concrete or other structural material. A major part of applications from both sides of the community, research and industrial user, was demanding the high resolution setup on DINGO and asking for an upgrade to achieve resolution below 25µm pixel size.

2. EXPERIMENTAL METHOD

In the original design DINGO [1] could provide a minimum pixel size of 27 µm. The neutron beam size can be adjusted to the sample size from 50 x 50 mm² to 200 x 200 mm² with a resulting pixel size from 27µm to ~100µm. The measured flux (using gold foil) at this high resolution setup for an L/D of approximately 1000 at HB-2 is 1.1*10⁷ [n/cm²s], which is in a similar range to other facilities. Depending on the sample composition a full tomography has been taken in 24 – 36 hours with a 50 µm thin ZnS/6LiF-screnn and the CCD (Andor IKON-L) camera. In a two stage upgrade the background radiation has been reduce by an additional slit system adjusting the beam size more flexible and further down to 0.5 x 0.5 mm². The new system allows minimizing the beam according to the sample size. In combination with the Andor IKON SCMOS and Kenko distance rings, to increase the focal length of the existing 100mm lens the pixel size was reduced to 7µm. The scintillator was a 10 µm thick Gadox screen and for each projection we have taken 3 – 6 images for better white spot correction. We would like to present first radiography and tomography results using the new setup. A full tomography under these conditions can be taken in 2 - 4 days depending on the nature on the sample.

In addition we have now a slit system installed to adjust the beam size even further to each individual sample. This new slit system reduces noise in form of white spots in the high resolution setup with small pixel size from 5- 20 µm by up to 70%. An overall range of pixel size from 5µm to ~100µm can be achieved now. The whole instrument operates in two different positions, one for high resolution and one for high speed.
3. RESULTS

We will show the performance of new the CMOS camera IRIS 15 with a 2960 x 5060 pixels chip and a physical pixel size of 4.5 µm. In combination with new scintillation screens like Gadox/LiF mixed screen it enables DINGO to run neutron tomography experiments with 5-10 µm resolution on large samples in a reasonable time of 24 -48 hours.

As a last step toward higher resolution we will report on progress of the neutron microscope [2], delivered by PSI, with first images and tests. This custom made lens with a special 3µm thick isotope enriched Gadox-screen [3] has shown neutron radiographs with 2.5µm pixel size and a resulting 5µm optical resolution.

References


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