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High resolution radiographic detector based on multi-channel-plate.

The aim of this project is to increase the efficiency of the prototype of the imaging detector dedicated for NDT (non-destructive-testing) industrial radiography. This prototype was built in National Centre for Nuclear Research, Poland.

The main part of the detector is 10x10cm pixelized scintillator based on GEM foil, used as a multi-porous-material (and not as an electron amplifier). Dedicated GEM foil was produced with the holes diameter 50um, while the distance between holes centers is 80um. Also, the holes in the GEM foil are not hourglass-shaped walls, but straight for bigger capacity.

In each hole the powdered GADOX scintillator has been placed and then locked by transparent cover. Flat distribution of the Gadox powder was achieved thanks to the use of ultrasonic densification and Gadox powder sedimentation.

Such pixelized scintillator converts X-rays into visible green light, reflected then by front-covered mirror and transported through optical elements to high-efficiency CMOS camera. Problem of dark-areas of the detector has been solved by fast movement of the pixelized scintillator in the detector, which covers all dead-areas. Achieved image resolution is much better than commercially available industrial imaging detectors (so-called flat panels, for example from Perkin Elmer or GE).

In this project we need to develop more advanced technology to increase the efficiency of pixelized scintillator. The following ideas has been proposed:

- to cover the inner part of 50um dia holes of the GEM foil by reflective Ni layer to increase the visible light transmission
- to make a light-guide within each hole by mixing the Gadox powder with some transparent resin
- to increase the thickness of the pixelized converter by precise multi-stacking of 10 GEM foils, thus to achieve 0.5mm scintillator thickness, still having 50um pixel size
- to decrease the distances between neighboring holes to minimize dark-areas. At the moment all dark areas are covered by fast movement of the pixelized scintillator during every exposition.

All developed techniques will be used to build the bigger, 40cm x 40cm imaging area detector, prototype no. 2.

It will be my pleasure to present already achieved results (images obtained on existing prototype in comparison to commercially available detectors) and to describe the ideas for increasing the efficiency of the detector (thus, to get shorter time of industrial imaging and/or lower required X-ray dose).

Summary

A prototype imaging detector based on multi-channel plate has been built. As a multi-channel plate, a dedicated GEM has been used, with more dense holes distribution and lowered holes diameter. Each hole was filled with powdered Gadox scintillator. Thus, in effect the pixelized scintillator has been created.

Achieved resolution based on the pixelized scintillator installed in fluoroscopic detector is 63 um. The aim is to use this detector in industrial radiography field. The advantages are: possible big imaging areas, high resolution, radiation resistivity. Observed disadvantages: poor efficiency. Technological R&D is required to increase the efficiency of pixelized scintillator.

Primary author: Prof. WRONKA, Slawomir Artur ((PL))

Co-author: Mr DZIEWIECKI, Wojciech (NCBJ)

Presenter: Prof. WRONKA, Sławomir Artur ((PL))