Thin Scintillator Imaging Screens

P. Horodysky[1], J. Tous[1], K. Blazek[1], M. Nikl[2], Yu. Zorenko[3], M. Kucera[4]

[1]*Crytur Ltd., Turnov, Czech Republic*

[2]*Academy of Sciences of the Czech Republic, Institute of Physics, Prague, Czech Republic*

[3]*I. Franko National University, Electronic Department, Lviv, Ukraine*

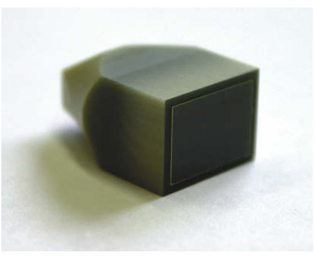
[4]*Charles University, Faculty of Mathematics and Physics, Prague, Czech Republic*

Scintillation Materials for Imaging Screens

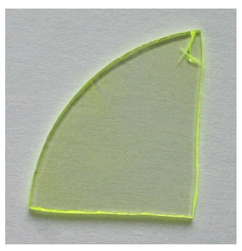
Yttrium aluminum garnet activated by cerium is a fast scintillator with excellent mechanical and chemical resistance. YAG:Ce scintillation detectors are the preferred choice for electron microscopy, beta and X-ray counting, as well as for electron and X-ray imaging screens.

Lutetium aluminum garnet activated by cerium or europium is a scintillator with high absorption to X-ray radiation and excellent mechanical and chemical resistance. LuAG:Ce scintillation detectors are the preferred choice for X-ray radiography imaging screens.

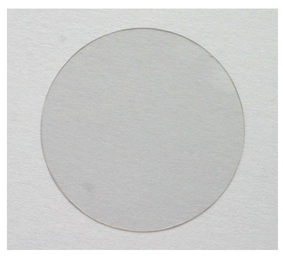
5 m thin YAG:Ce screen



Thin YAG:Ce screen on FOP



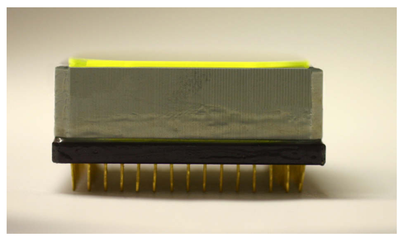
LPE LuAG:Ce sample



LPE LuAG:Eu screen

High Spatial Resolution Imaging Systems

High-resolution X-ray imaging digital camera



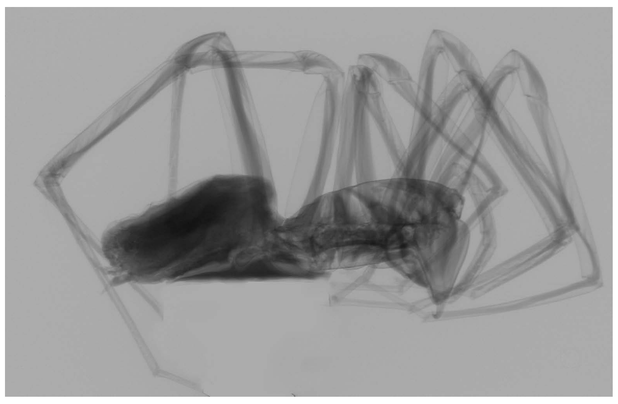
High-resolution digital camera for TEM

High resolution imaging system is a combination of a high sensitive digital CCD camera and an optical system with a thin scintillator imaging screen. The screen is the YAG:Ce ($Y_3Al_5O_{12}$) or the LuAG:Ce ($Lu_3Al_5O_{12}$) inorganic scintillator. These materials have the advantages in the mechanical and chemical stability, non-hygroscopicity, and a high radiation hardness.
Very thin (down to 5 microns) screens of YAG:Ce were developed for imaging applications requiring high spatial resolution. Crytur also integrated these plates into CCD camera enabling imaging of objects in X-ray and electron beams with high resolution.

High Resolution Application in X-ray Radiography

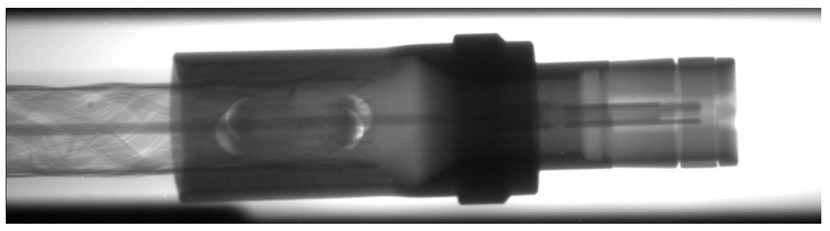
Other applications:
- *X-ray spectroscopy*
- *X-ray topography*
- *X-ray beam adjustment*
- *X-ray thin films diffraction*
- *X-ray optics adjustment*
- *X-ray microfocus spot measurement*
- *X-ray imaging in industry*
- *X-ray food inspection*

... and many others



X-ray radiography of a Spider

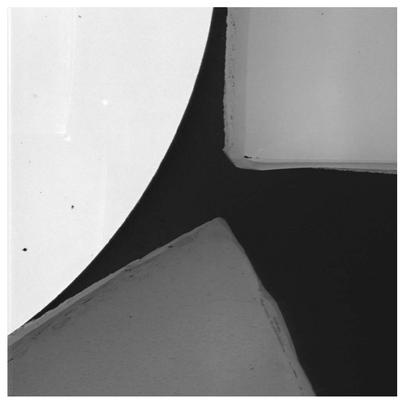
The images were taken using a microfocus X-ray tube with Cu anode@ 40kV/2mA



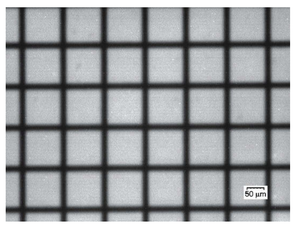
X-ray Inspection of fine wires in a data cable

Thin Screens Characterization

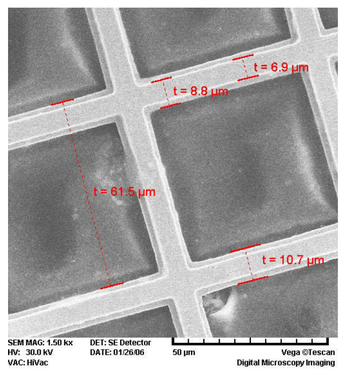
Characterization technique/property	Nuclear emitter	SEM/Cathodoluminescence	X-ray/CCD
Repeatability	Very good (1-2%)	Good	Good
Spectral sensitivity	300-600 nm, limited by bialcali cathode of PMT, more sensitive at blue/UV	300-700 nm, limited by bialcali cathode of PMT, more sensitive at blue/UV	Silicon sensitivity, very good, more sensitive at red VIS
Dynamic range	Lower limit is about 20% efficiency of standard single-crystal YAG:Ce	Good, due to large dynamic electron current and PMT voltage	Good, limited by acquisition time
Absorption depth	3 m using ^{67}Ni emitter (max. 67 keV beta)	From 20 nm to 1 m, depending on electron beam acceleration voltage	Full depth of layer
Imaging of homogeneity	No	Limited field of view (3x3 mm^2)	Limited by CCD chip size and optical magnification (max. 36x24 mm^2)



SEM/CL image of Czochralski grown YAG:Ce and LPE LuAG:Ce



Grid imaged by Czochralski YAG:Ce thin plate



SEM image of the test grid

The support of Czech GA AV project KAN300100802 is gratefully acknowledged.