Argonne NATIONAL LABORATORY

Office of Technology Transfer

Glass-ceramic X-ray Storage Phosphors for High-resolution Medical Imaging

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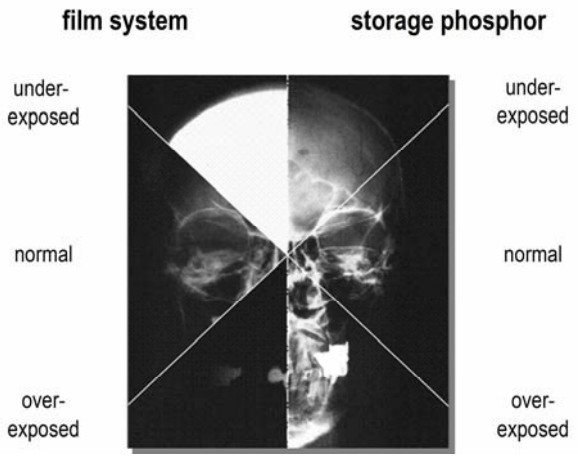
X-ray storage phosphor (XRSP) plates are now widely used in medical and non-destructive testing radiography. These plates, commonly made from the photo-stimulable phosphor BaFBr:Eu^{2+}, have many advantages over traditional photographic film/scintillating screens, such as re-usability, wide dynamic range, and direct digitization. However, the typical spatial resolution of 2.5 line pairs/mm is inferior to that of film, about 5 line pairs/mm, so film is still used for high-resolution radiography applications such as mammography. The image is stored in the form of the spatial variation of the concentration of radiation-induced electrons and holes that are trapped at defect centers. The electrons and holes are stable in the traps after irradiation but can be induced to recombine by illumination with a red laser beam. The energy of the electron-hole recombination is transferred to the europium ions to give photo-stimulated luminescence, which is detected by a photomultiplier (PM) tube. Raster scanning the focused laser beam generates the image signal from the PM tube. However, because the stimulating laser beam is scattered outside the bounds of the focal spot volume by the powder grains of the BaFBr crystals, the read-out area extends substantially beyond that focal spot, degrading the resolution. In an attempt to overcome this limitation, we have been developing glass-ceramic materials that show an XRSP effect and are transparent or semi-transparent, thus exhibiting less light scattering than powdered crystalline materials.

The specific materials that we have studied so far are primarily fluoride glasses containing europium-doped binary and ternary halide nano-crystals. These new materials have a higher spatial resolution than powdered crystalline materials and are good candidates for medical x-ray imaging applications, such as high-resolution mammography. Work supported by the National Institutes of Health under grant No. R21 EB02928.



Under- and overexposure for a scintillator-film system and an x-ray storage phosphor. Due to the higher dynamical range of the storage phosphor the image can be digitally corrected afterwards

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