Studying the luminescence efficiency of Lu_2O_3:Eu nanophosphor material for digital X-ray imaging applications.

Autorzy

N. Kalyvas

P. Liaparinos

C. Michail

S. David

G. Fountos

Marcin Wójtowicz

Eugeniusz Zych

I. Kandarakis

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Streszczenie

Scintillator materials are widely used in X-ray medical imaging detector applications, coupled with available photoreceptors like radiographic film or photoreceptors suitable for digital imaging like a-Si, charge-coupled devises (CCD), complementary metal-oxide-semiconductors (CMOS) and GaAs). In addition, scintillators can be utilized in non-medical imaging detectors such as industrial detectors for non-destructive testing (NDT) and detectors used for security purposes (i.e. airport luggage control). Image quality and dose burden in the above applications is associated with the amount of optical photons escaping the scintillator as well as the amount of optical photons captured by the photoreceptor. The former is characterized by the scintillator efficiency and the latter by the spectral matching between the emission spectrum of the scintillator and the spectral response of the photoreceptor. Recently, a scintillator material, europium-activated lutetium oxide (Lu_2O_3:Eu), has shown improved scintillating properties. Lu_2O_3:Eu samples of compact nanocrystalline non-agglomerated powder were developed in our laboratory using homogeneous precipitation from a water-toluene solution in the presence of polyvinyl alcohol as a surfactant. In order to test their light-emission properties, experimental measurements under the excitation of X-ray spectra with X-ray tube voltages between 50 kVp and 140 kVp were performed. This range of applied voltages is appropriate for X-ray radiology, NDT and security applications. Lu_2O_3:Eu was evaluated with respect to output yield and spectral compatibility of digital imaging photoreceptors (CCD-based, CMOS-based, amorphous silicon a:Si flat panels, ES20 and GaAs). High light yield and spectral compatibility increase the performance of the medical detector and reduce the dose burden to the personnel involved. In addition a theoretical model was used to determine the values for the Lu_2O_3:Eu optical photon light propagation parameters. The inverse diffusion length was found to be equal to 33 cm^2/g. In addition Lu_2O_3:Eu was found to match well with several photoreceptors capable of digital imaging (i.e. GaAs).

Słowa kluczowe

GaAs, Optical Sensor, Phosphor Screen, Spectral Match, Optical Photon

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