



Imaging performance of a thin $\text{Lu}_2\text{O}_3:\text{Eu}$ nanophosphor scintillating screen coupled to a high resolution CMOS sensor under X-ray radiographic conditions : comparison with $\text{Gd}_2\text{O}_2\text{S}:\text{Eu}$ conventional phosphor screen.

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Streszczenie

The purpose of the present study was to experimentally evaluate the imaging characteristics of the $\text{Lu}_2\text{O}_3:\text{Eu}$ nanophosphor thin screen coupled to a high resolution CMOS sensor under radiographic conditions. Parameters such as the Modulation Transfer Function (MTF), the Normalized Noise Power Spectrum (NNPS) and the Detective Quantum Efficiency (DQE) were investigated at 70 kVp under three exposure levels (20 mAs, 63 mAs and 90 mAs). Since $\text{Lu}_2\text{O}_3:\text{Eu}$ emits light in the red wavelength range, the imaging characteristics of a 33.3 mg/cm^2 $\text{Gd}_2\text{O}_2\text{S}:\text{Eu}$ conventional phosphor screen were also evaluated for comparison purposes. The $\text{Lu}_2\text{O}_3:\text{Eu}$ nanophosphor powder was produced by the combustion synthesis, using urea as fuel. A scintillating screen of 30.2 mg/cm^2 was prepared by sedimentation of the nanophosphor powder on a fused silica substrate. The CMOS/ $\text{Lu}_2\text{O}_3:\text{Eu}$ detector's imaging characteristics were evaluated using an experimental method proposed by the International Electrotechnical Commission (IEC) guidelines. It was found that the CMOS/ $\text{Lu}_2\text{O}_3:\text{Eu}$ nanophosphor system has higher MTF values compared to the CMOS/ $\text{Gd}_2\text{O}_2\text{S}:\text{Eu}$ sensor/screen combination in the whole frequency range examined. For low frequencies (0 to 2 cycles/mm) NNPS values of the CMOS/ $\text{Gd}_2\text{O}_2\text{S}:\text{Eu}$ system were found 90% higher compared to the NNPS values of the CMOS/ $\text{Lu}_2\text{O}_3:\text{Eu}$ nanophosphor system, whereas from medium to high frequencies (2 to 13 cycles/mm) were found 40% higher. In contrast with the CMOS/ $\text{Gd}_2\text{O}_2\text{S}:\text{Eu}$ system, CMOS/ $\text{Lu}_2\text{O}_3:\text{Eu}$ nanophosphor system appears to retain high DQE values in the whole frequency range examined. Our results indicate that $\text{Lu}_2\text{O}_3:\text{Eu}$ nanophosphor is a promising scintillator for further research in digital X-ray radiography. © (2014) COPYRIGHT Society of Photo-Optical Instrumentation Engineers (SPIE). Downloading of the abstract is permitted for personal use only.

Słowa kluczowe

Lu_2O_3 , Eu, nanophosphor, Digital Radiography, Image quality

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