고효율 X선 검출기 적용을 위한 PbO 필름 제작 및 특성 연구

조성호, 강상식, 최치원[1], 권철[1], 남상희[2]
인제대학교 의용공학과 방사선영상연구실, [1]인제대학교 의료영상과학대학원, [2]인제대학교 의용공학과

Fabrication and Characterization of Lead Oxide (PbO) Film for High Efficiency X-ray Detector

Sung-ho Cho, Sang-sik Kang, Chi-Won Choi[1], Chul Kwun[1], Sang-hee Nam[2]
Radiation Image Lab. in Inje Univ., [1]Dept. of Medical Imaging & Science in Inje Univ.,
[2]SDept. of Biomedical Engineering in Inje Univ..

Abstract : Photoconductive polycrystalline lead oxide coated on amorphous thin film transistor (TFT) arrays is the best candidate for direct digital x-ray detector for medical imaging. Thicker films with lessening density often show lower x-ray induced charge generation and collection becomes less efficient. In this work, we present a new methodology used for the high density deposition of PbO. We investigate the structural properties of the films using X-ray diffraction and electron microscopy experiments. The film coatings of approximately 200 ㎛ thickness were deposited on 2"×2" conductive-coated glass substrates for measurements of dark current and x-ray sensitivity. The lead oxide (PbO) films of 200㎛ thickness were deposited on glass substrates using a wet coating process in room temperature. The influence of post-deposition annealing on the characteristics of the lead oxide films was investigated in detail. X-ray diffraction and scanning electron microscopy, and atomic force microscopy have been employed to obtain information on the morphology and crystallization of the films. Also we measured dark current, x-ray sensitivity and linearity for investigation of the electrical characteristics of films. It was found that the annealing conditions strongly affect the electrical properties of the films. The x-ray induced output charges of films annealed in oxygen gas increases dramatically with increasing annealing temperatures up to 500 ℃ but then drops for higher temperature anneals. Consequently, the more we increase the annealing temperatures, the better density and film quality of the lead oxide. Analysis of this data suggests that incorporation and decomposition reactions of oxygen can be controlled to change the detection properties of the lead oxide film significantly. Post-deposition thermal annealing is also used for densely film. The PbO films that are grown by new methodology exhibit good morphology of high density structure and provide less than 10 pA/mm^2 dark currents as they show saturation in gain (at approximate fields of 4 V/㎛). The ability to operate at low voltage gives adequate dark currents for most applications and allows voltage electronics designs.

Key Words : PbO, X-ray Detector, Solution Combustion