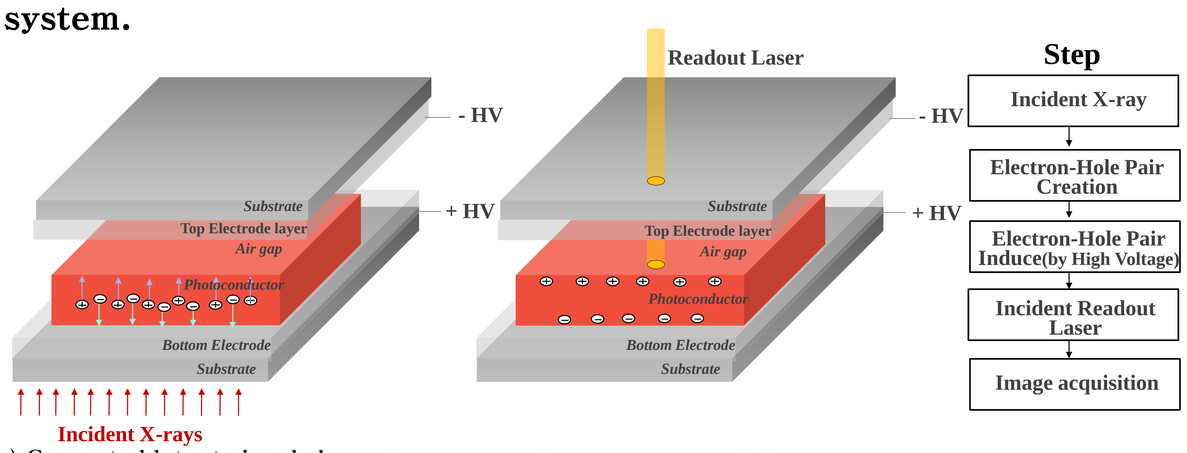
The implementation of photoinduced discharge X-ray detector using photoconductor

Young Kyu LEE[1], Kyung Min OH[1], Sung Hun KIM[1], Ji Yun LEE[2], Sang Sik KANG[3], Kyoung Jun YOON[4], Sang Hee NAM [1 5]

[1]Department of Biomedical Engineering, Inje University, Gimhae 621-749, Republic of Korea
[2]BIOMEDICAL Department of Biomedical Engineering, Inje University, Gimhae 621-749, Republic of Korea
[3]Department of Radiology Science, International University of Korea, Jinju 660-759, Republic of Korea
[4]Gimhae Bio-Medical Center, Gimhae, Gyungnam 621-842, Korea
[5]Department of Biomedical Engineering & Medical Imaging Research Center, Inje University, Gimhae 621-749, Republic of Korea

1. Introduction

In this study, properties of photoconductors for photo induced discharge were investigated for the application in digital x-ray imaging system. The conventional direct x-ray conversion method, has been showed many problems such as TFT damage by high operating voltage, low image quality by TFT noise and its specific pixel size, and difficulties in fabrication process. Therefore, digital x-ray sensing system with photo induced discharge technique would be a prospect method which can replace the conventional method. Photoinduced discharge x-ray detector is to use a latent image created at the photoconductor layer and to read out the latent image by photoinduced discharge. Also, since photoinduced discharge x-ray detector use laser to readout latent signals, the resolution of image would be determined by the size of resolution instead of the size of TFT pixel, which can improve the image quality in digital x-ray system.



(a) Generated latent signals by x-ray (b) Signal readout by PID method

Fig 1. The principle of photoinduced discharge x-ray detector

2. Experimental Procedure

Experiment procedure

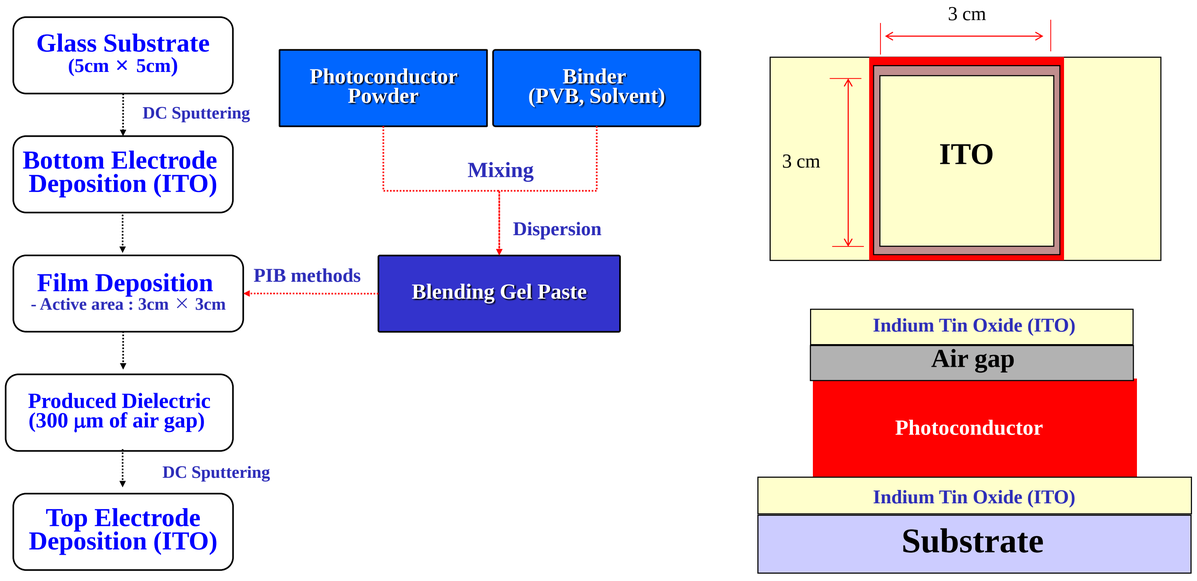


Fig 2. Sample fabrication procedures for photoinduced discharge x-ray detector

Electrical properties measurement

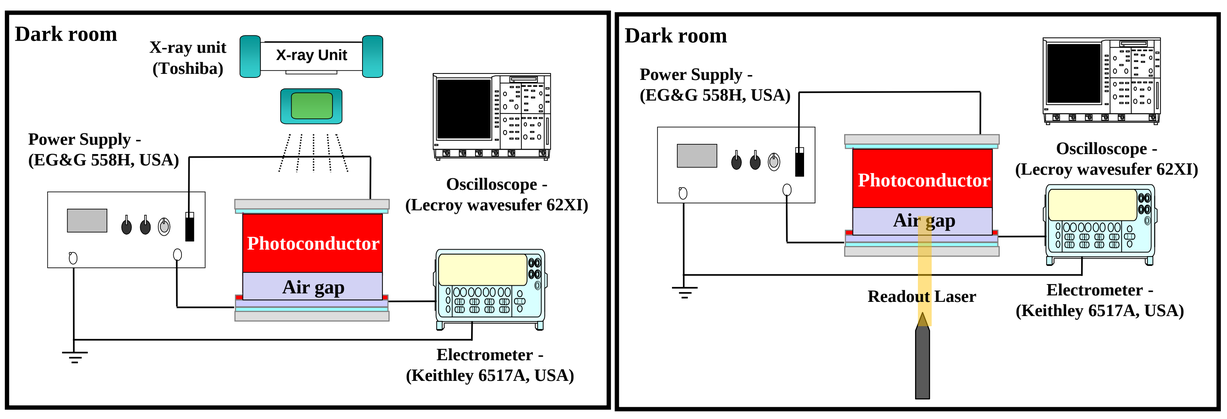


Fig 3. Electrical signal measurement

After x-ray exposure, the latent signals generated by x-ray energy was created in photoconductor layer. In order to readout the latent signals, two kinds of laser, green light with about 500nm of wave length and red light with 620nm of wave length were exposed on photoconductor which contain latent signal.

3. Result

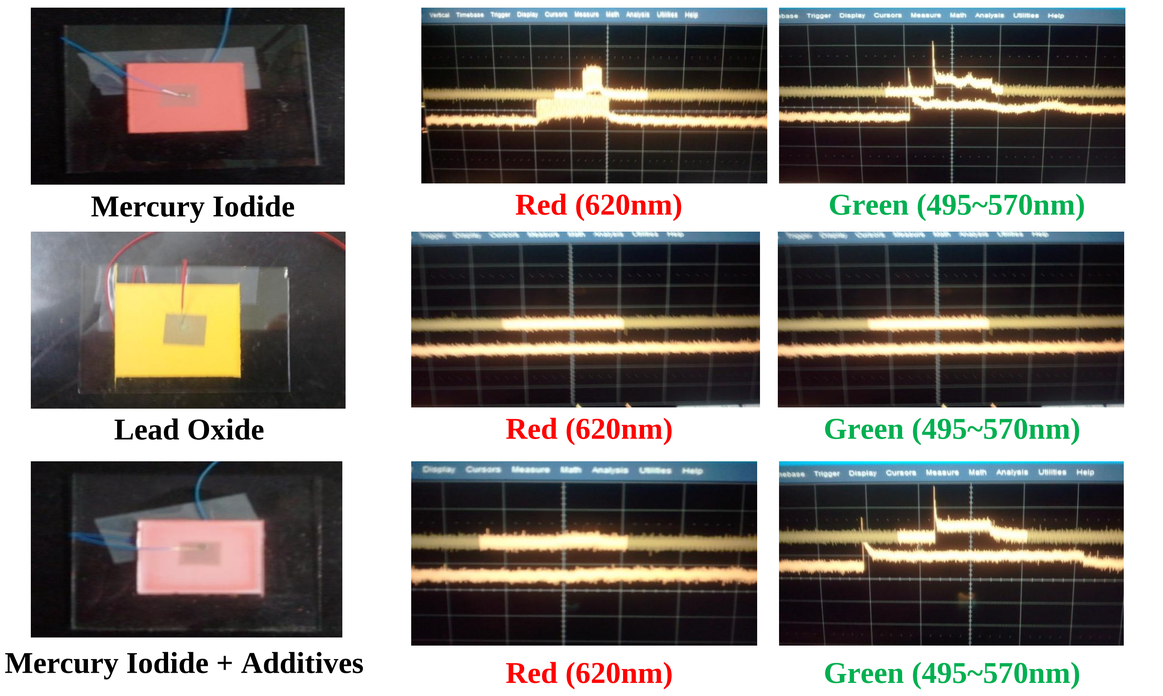


Fig 4. Response of three type samples by Laser

The result showed that there is no obtained signals from Lead Oxide because Lead Oxide film did not response on the light wave length of 620nm of red light and 495~570nm of green light. In the case of HgI2 film, latent signals were achieved since the absorption wave length of HgI2 was matched with the wave length of both red and green light. The case of mixed Mercury Iodide, the latent signals were obtained only by green laser.

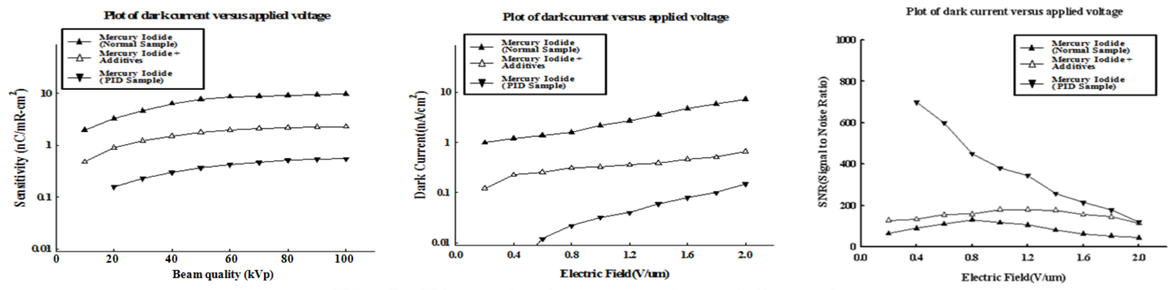


Fig 5. Electrical properties of Samples

4. Conclusion

To improve conventional digital radiography, the feasibility of the photoinduced discharge x-ray detector was confirmed. As photoconductors which contain latent signals by x-ray energy, HgI_2, PbO, and synthesized HgI_2 were used in this study. As a dielectric film in this structure, 300um of air gap thickness was used in order for photoconductors to contain latent signal. To find out electronic properties of photoconductor materials for the photoinduced discharge x-ray detector, electrometer and oscilloscope are used. As a result, PID x-ray detector made by both HgI2, PbO, and synthesized HgI2 showed lower leakage current than digital direct x-ray conversion method. However, the wave length of laser should be optimized to obtain sufficient latent signals in the photoconductors. Though the sensitivity achieved by the PID samples showed lower than normal samples which use the conventional direct conversion method, the dark current of PID samples showed much lower than that of normal samples, which can cause a lot higher signal to noise ratio. In this study, the feasibility of photoinduced discharge x-ray detector was confirm, and as the future work, we need to conduct optimization process to improve the efficiency of PID x-ray detector.

5. Acknowledgment

This work(research) is financially supported by the Ministry of Knowledge Economy(MKE) and Korea Institute for Advancement in Technology (KIAT) through the Workforce Development Program in Strategic Technology