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TlBr Photon Counting X-ray imager

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TlBr has been recently studied as a compound-semiconductor radiation detector operating at room temperature, because of its large atomic number (Tl:81, Br:35), high density (7.56 g/cm3) and large band gap of 2.68 eV, which makes it suitable for room temperature operation, it has the necessary low thermal noise. In addition, it has a low melting point of 460℃, which facilitates crystal growth, and direct growth on LSI substrates can be expected. The resistivity is as high as 10^10Ωcm with very low leakage current, making it a good semiconductor material for radiation detectors, which is suitable for photon counting methods to detect pulse per photon. However, it has a problem of ionic conductivity and its properties deteriorate over a long period of time, and it has been reported that the time degradation characteristics can be improved by using a Tl electrode.
In this study, by applying the latest 3D-IC fabrication technology, we have fabricated an X-ray imaging device by bonding the TlBr crystals to our original signal readout LSI. The signal processing method converts the charge generated in the TlBr semiconductor X-ray detector directly from the charge to a digital signal without converting it to a voltage. This combination has resulted in a photon counting TlBr X-ray imaging device. We were able to capture X-ray transmission images in test imaging. Challenges and their solutions in long-time operation are also discussed.

Topics

Session C. Applied optics and engineering

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