Contribution ID: **59** Type: **Oral**

Evaluation of the photoelectric effect of X-rays for Gallium Nitride

Saturday, 26 November 2022 09:15 (15 minutes)

Ge detectors are widely used as X-ray/γ-ray detectors, but they cannot operate at room temperature due to narrow bandgap, must be cooled with liquid nitrogen. As a better material, CdTe, which can operate at room temperature and has a large attenuation coefficient, is becoming more widely used. However, compared to Ge, the manufacturing process has not been optimized and the manufacturing cost is high.

We propose the use of Gallium Nitride (GaN) as a new semiconductor detector material. GaN is a wide bandgap semiconductor that has been used in many products in the fields of power devices and optical devices. GaN is in great demand in those markets. Therefore, the manufacturing process is optimized, and it is expected to low manufacturing cost.
GaN has a large attenuation coefficient, exceeds that of CdTe in the energy range of 10-26 keV. Despite such excellent characteristic, sufficient experimental data on GaN as a radiation detector have not been obtained.

To demonstrate that GaN can be used as a radiation detector, we measured the photoelectric effect when GaN pn diodes were irradiated with X-rays. A pn diode structure was fabricated by epitaxial growth of 2μm p-type GaN on a 350μm thick n-type GaN substrate.

As a result of the experiment, it was shown that the current increased in proportion to the intensity of the irradiated X-ray. However, the current change is very small, about 10 nA, indicating that the structure needs to be modified for practical use.

Topics

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Session Classification: Applied Optics