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Electrical Characterization of Thallium Bromide Crystals

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X-ray imaging technology has applications in medicine, nondestructive testing at industrial sites, and security inspections at airports.
Today, semiconductor detectors are widely used as radiation detectors. Because semiconductor detectors convert X-rays directly into electric charge, they are considered to have higher spatial resolution than scintillator-type detectors, which convert X-rays once into visible light.
In gamma-ray measurements, detectors using CdTe are widely used as semiconductor detectors that work at room temperature, but we focused on thallium bromide (TlBr), one of compound semiconductors. The TlBr detector can operate at room temperature with a band gap of 2.68 eV, and is expected to have higher detection efficiency than CdTe at higher energies due to its high atomic number (81 for thallium and 35 for bromine) and density (7.56 g/cm3). However, it has the disadvantage of longer rise time due to its lower carrier mobility than CdTe. Therefore, it is necessary to apply a high electric field for high-speed charge transfer, and we strive to create a diode. For this purpose, it is necessary to clarify the electrical characteristics of TlBr.
Therefore, in this study, a sample of TlBr crystal was vacuum-deposited with Tl as an electrode. Then, in order to clarify the electrical properties of TlBr, such as polarity and mobility, whether TlBr is n-type or p-type, Hall effect measurements and current-voltage characteristics were performed.

Topics

Session C. Applied optics and engineering

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