Growth of High Resistive $Cd_{0.85}Mn_{0.15}Te$ Single Crystal Using Vertical Bridgman Method for Ambient Temperature Gamma-Ray Detectors

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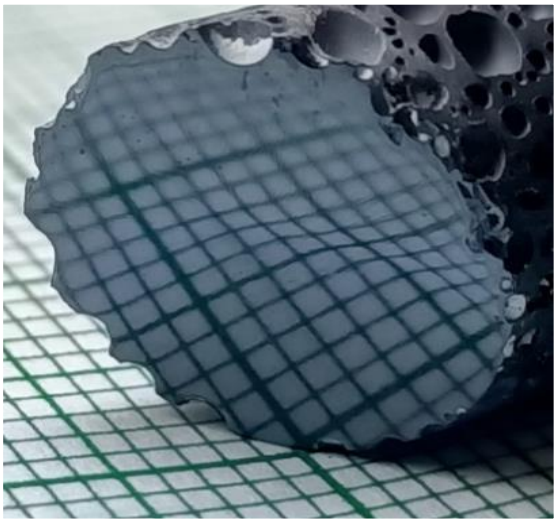
CdMnTe single crystals are considered a good candidate for room temperature γ-ray detector applications. The substitution of Mn in CdTe improves the performance of large-volume detectors due to the better electronic characteristics. Also, the growth of CdMnTe crystal with good structural and compositional uniformity is possible since the segregation co-efficient of Mn in CdTe lattice is nearly unity. In this work, the $Cd_{0.85}Mn_{0.15}Te$ (CMT) single crystal was grown using the vertical Bridgman method. The grown crystal was subjected to powder XRD analysis to confirm the CMT phase formation. The lattice parameter was estimated using single crystal XRD analysis and found to match well with the theoretical value. The obtained Laue pattern also confirmed the single crystalline nature with the threefold symmetry of the grown CMT crystal. The CMT wafers of 3 mm thickness were cut in four different regions along the growth axis of the crystal. The wafers were subjected to NIR, FTIR, micro-Raman and PL spectroscopy to analyse the compositional uniformity and optical properties of the crystal. Ohmic contacts were made by the electroless deposition method using $AuCl_3$ solution and a metal-semiconductor-metal (MSM) system was fabricated. Surface leakage current and bulk resistivity of the CMT crystal were analysed by I-V measurements and bulk resistivity is found to be as high as ~ Gohms-cm. The fabricated CMT element was irradiated with a γ-ray source to analyse the response and the resolution of the detector. The charge collection efficiency of the detector was calculated under a different bias voltage. Growth of high resistive CMT crystals with a reasonable response to gamma rays was demonstrated using the Brigman technique.



As grown $Cd_{0.85}Mn_{0.15}Te$ single crystal