Growth of detector-grade CdTe crystal by the Vertical Gradient Freeze method with a Cd reservoir

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CdTe has gained increasing interests for medical applications, especially after Siemens Medical announced its NAEOTOM Alpha, the world's first photon-counting CT scanner, equipped with CdTe crystals. Growth of CdTe crystal suffers from the problems of Cd-related point defects and its inhomogeneity caused by the high Cd partial pressure, deteriorating its electrical properties for detector applications. Here, we report the detector-grade CdTe crystal growth by the Vertical Gradient Freeze (VGF) method. A Cd reservoir with dynamic adjusting of the temperature according to the P-T-X phase diagram was used to balance the Cd partial pressure during the crystal growth and in-situ annealing stage.

CdTe crystals with a diameter of 2inch were obtained. It is found that the size and concentration of Te inclusions are correspondingly reduced with sizes mainly distributed between 0 and 2 μ m, and a concentration between 3.3 and 5.4×10^{2} cm^{-2}. The overall uniformity is also improved compared with the crystals grown without Cd reservoir. The dislocation density is quite low, which is about $3\text{-}5\times10^{3}$ /cm^{2}.

The dopant of Cl was used to improve the electrical properties. Inclusion free ingots were got by adjusting the temperature of Cd reservoir and thus the Cd partial pressure. Low temperature photoluminescence spectrum (PL) shows that the defect types mainly include A-center, Cd vacancy, and other related defects. The resistivity of CdTe: Cl crystal is up to 10^{10} Ω·cm, which is even higher than the theoretical values. The distribution of the resistivity is uniform along both the axial and radial directions. According to the fitting calculation of the α particle's energy spectrum response and the time of flight measurements, the electron mobility lifetime products was determined to be 1.1×10^{-4} $cm^{2}\cdot V^{-1}$, and the electron mobility is 1075 $cm^{2}\cdot V^{-1}\cdot s^{-1}$. The energy responses of CdTe:Cl on ^{241}Am@5.48 MeV α particles and ^{137}Cs@662 keV γ-ray were evaluated based on devices with different contact types.

CdTe crystal grown from the VGF method with Cd reservoir improves not only the Cd-related defects but also the uniformity, which proves a broad prospect in the imaging device applications.