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Purification of $Cd_{1-x}Zn_xTe$ crystals from Te inclusions by the "dry zone" method

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Short abstract

Cd(0.9)Zn(0.1)Te crystals grown by the Bridgman technique with excess Te were subjected to heat treatment (HT) by the "dry zone" method. The velocity of the zone was 0.25 mm/h, and the temperature of the hot zone was 510 C and 600 C for two different crystals. The density of Te inclusions and the electrophysical properties of the crystals before and after HT were studied. As a result, the density of inclusions decreased from 10^(5) cm^(-3) in the initial crystals to 0-10 cm^(-3) after the HT. Relatively large volumes without tellurium inclusions were observed in the crystals after purification. The concentration of electrically active centers in the crystals before and after heat treatment was determined using studies of the temperature dependencies (T=90-400 K) of the specific conductivity and Hall coefficient. It was found that the crystals were purified, not only from inclusions, but also from uncontrolled impurities due to gettering of the impurities by inclusions.

Expanded abstract

Cd(Zn)Te crystals are widely used for producing X- and gamma-ray detectors. A large number of Te-rich inclusions enriched by uncontrolled impurities often remain in the as-grown crystals. In this work we present studies of the purification by Te inclusions in Cd(Zn)Te crystals using a hot "dry zone" method, which moves along the growing crystal. For this purpose, a mechanism for moving the molten Te phase, similar to that used in the traveling heater method, was used, but without a tellurium weight at the beginning of the zone movement.

The Bridgman technique was used to produce Cd(0.9)Zn(0.1)Te crystals with 0.5 atomic % Te excess. Grown crystals were next subjected to heat treatment (HT) by the "dry zone" method. The velocity of the zone was 0.25 mm/h, and the temperature of the hot zone was 510 C (crystal 1) and 600 C (crystal 2). Comparison of the infrared images of Cd(Zn)Te samples before and after HT show the efficiency of the "dry zone" method at both temperatures; better results were obtained at the higher temperature of 600 C. Small inclusions (about 5 microns in size) were eliminated, and a decrease in the size of large (~ 20 microns) inclusions was detected. The density of inclusions decreased from 10^(5) cm^(-3) in the initial crystal to 0-10 cm^(-3) after purification.

The concentration of electrically active centers in the crystals before and after HT was determined from studies of the temperature dependencies (T=90-400 K) of the specific conductivity and Hall coefficient. It was found that the crystals were purified, not only from inclusions, but also from uncontrolled impurities due to gettering of impurities by the inclusions. In particular, the total concentration of ionized scattering centers after HT was about (2-3)x10^(16) cm^(-3) in crystal 1 and (4-5)x10^(16) cm^(-3) in crystal 2, which is an order less than before HT.