

Charge Transport and Low Temperature Phenomena in Single Crystal CdZnTe

Matthew Veale

Abstract

Cadmium Zinc Telluride (CdZnTe) has been the focus of intense research in recent years and is regarded as the material of choice for the production of the next generation of X-ray and gamma ray detectors. Recently the first commercial CdZnTe based detectors have become available but are still very expensive owing to the poor yield obtained using current growth processes.

This work focuses on the characterisation of material produced using the modified vertical Bridgman (MVB) technique and the traveling heater method (THM); a number of key material properties are studied and the effect these have on the detector performance. The crystalline quality and homogeneity of each crystal is evaluated and from these measurements it is seen that the measured inclusion density is directly related to the spectroscopic performance observed at typical X-ray and γ -ray energies.

Measurements of the charge transport properties both at room temperature and low temperature show there to be major differences between the MVB-grown and THM-grown materials. The electron transport properties of the MVB material are poorer than those of the THM material; low temperature measurements are used to show this may be related to a donor defect peculiar to the MVB material. Measurements using the PICTS technique also demonstrate an increased number of defects and impurities in the MVB samples leading to the conclusion that the better spectroscopic performance observed in THM samples is due to an increased level of purity.