

Properties of $\text{Cd}_{1-x}\text{Mn}_x\text{Te}$ as a room temperature semiconductor radiation detector

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Abstract

Cadmium Manganese Telluride (CdMnTe) has many properties that make it an excellent candidate for use as a room temperature radiation detector material. It has a highly tunable band gap, can be grown in large single crystals, and has a high quantum efficiency. To realise the material's potential, however, a great deal more needs to be known about its electronic properties, and the impurities and defects limiting the charge transport properties.

This work investigates the optical and electronic properties of both un-doped and doped CdMnTe in an attempt to clarify the energy levels that exist within the band gap of the material and their effect on charge transport. The work centres first around photoluminescence, to determine energy levels in the material as well as uniformity of Manganese across samples. Next, particle induced charge pulses are used to determine the fundamental charge transport properties as well as trap energies calculated from the temperature dependence of thermal de-trapping times. Ion beam induced charge (IBIC) microbeam studies are carried out on a sample to identify sample uniformity, and to identify any extended defects that may exist.

Finally, the best X-ray resolution published so far for this material shows its potential for use as a room temperature gamma and X-ray detector. This result, combined with a summary of energy levels and impurity elements found in the samples investigated should provide invaluable information for the further development of this material. This may enable its quality to rival the more established and well understood CdTe and CdZnTe in the future.