Study of the interface shape of CdZnTe crystals grown by Vertical Bridgman for X-ray detector applications.

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CdZnTe crystals are currently used for the preparation of X-ray detectors. However, the large-scale exploitation of CdZnTe-based detectors is limited by the low single crystalline yield of the available growth techniques.

In particular, two problems connected with the growth process seem to be critical. The first one concerns with the first part of the growth: due to the presence of tellurium structures in the melt above the melting point, superheating is necessary, causing difficulties to standard seeding procedures. For this reason, unseeded growth is usually preferred, with the consequence that at least the first part of the growth is characterized by polycrystalline material. The second problem is connected with the difficulty to obtain a convex growth interface, basically because of the low thermal conductivity of CdZnTe crystals. This fact favors the development of spurious nuclei at the crucible walls. Some of the authors have recently proposed a modification of the vertical Bridgman technique that makes use of a boron oxide layer covering the melt during the growth.

In this work, the growth interface of several CdZnTe crystals grown by the vertical Bridgman technique, with and without the use of boron oxide to cover the charge, has been studied mainly by means of pholuminescence mapping, optical microscopy, and EDS microanalysis.

The results show that, even in the presence of a vertical thermal gradient of about 10°C/cm, considered ideal for achieving a good crystallization of CdZnTe crystals, nucleation often starts not from the lower tip of the crucible, but rather from lateral crucible walls. This seems to be due to a local modification of the thermal gradient due to the presence of the molten charge, the crucible, and the crucible support.

Moreover, while the first part of the main body of the crystal is characterized by a convex interface, the second half is characterized by a concave interface in the case of crystals grown without encapsulant. On the contrary, if the melt is covered by boron oxide, the interface is convex up to the end of the growth. The explanation of this experimental evidence can be found in the different thermal conductivity of boron oxide and vapor and in the fact that boron oxide separates the melt from the convective flows in the vapor.