CHARACTERIZATION OF TELLURIUM INCLUSIONS IN CdZnTe INGOTS GROWN BY VERTICAL BRIDGMAN TECHNIQUE.

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CdZnTe (CZT) crystals are employed for the preparation of room temperature operating X-ray detectors [1]. The functioning of the devices without refrigeration is made possible by growing high resistivity (>10^{10} Ohm·cm) ingots. This is usually reached by contemporarily doping with group III or group VII elements and using tellurium deviated charge. This second condition is responsible for the presence in crystals of a large number of tellurium inclusions. These can be incorporated at the growing interface or can form during cooling as a result of the retrograde behavior of the liquidus curve [2]. Unfortunately, inclusions severely limit the performances of CZT-based detectors, in particular in the case of imaging devices. In fact because of the role of diffusion of the electrons drifting from the cathode to the anode, tellurium inclusions act as traps for the charge carriers. Consequently the detector response close to the inclusions is deteriorated [3].

Hence, monitoring tellurium inclusion density is very important for assessing the material quality, selecting the best region in CZT wafer and for studying the formation mechanisms of inclusions during growth. Tellurium inclusions presence can be revealed by means of optical transmission microscopy in the near-infrared, in fact tellurium inclusions are opaque to the IR, while the CZT matrix is transparent. We developed an instrument for 3D mapping of inclusions mounted on a standard optical microscope with automatic vertical movement. Pictures are taken at different focal planes. Images are then elaborated by a dedicated software that ascribes each inclusion to the proper focal plane. As a result, all inclusions are counted and precisely localized in 3D. Using different objective lenses of the microscope it is possible to choose the optimal compromise between resolution and extent of the monitored area. However, at high magnification it is possible to map inclusions down to 1 micron diameter.

The spatial position information of tellurium inclusion obtained by 3D IR mapping was used to select a single inclusion in the sample and then acquire photoluminescence (PL) map in the selected region. The inclusion was placed very close to the surface (few microns) by etching the sample. A correlation was set between the PL spectra emission and the presence of tellurium inclusion.

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