# Advances in VGF Crystal Growth of $Cd_{1-x}Zn_xTe_{1-y}Se_y$ Alloys

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During the last three decades, extensive research has been done on the material development of CdTe (CT) and $Cd_{0.9}Zn_{0.1}Te$ (CZT) for spectroscopic room temperature X-ray and gamma radiation detectors. Moreover, the fabrication of CZT single crystals demands the production of large area wafers with low defect density, good compositional homogeneity, and uniform bandgap. In addition, high resistivity is required to develop other applications such as X-ray panel detectors, commonly used in medical applications [1]. However, there is an actual limitation in terms of the amount of thick CT and CZT single crystals and large area wafers that can be obtained due to the presence of defects in the crystalline matrix.

It has been recently shown that selenium addition to CZT matrix results in an effective lattice hardening and reduced Te inclusions and precipitates. It has also been reported that a certain amount of Se leads to a reduced zinc segregation compared to that appearing during the CZT growth. Therefore, resulting $Cd_{1-x}Zn_xTe_{1-y}Se_y$ (CZTS) crystals are harder, more homogeneous and showing better crystallinity than CT and CZT crystals [2].

In this work we report on our recent advances of our on-going [3] research on the Vertical Gradient Freeze (VGF) growth of high quality large diameter (two-inches) $Cd_{1-x}Zn_xTe_{1-y}Se_y$ ingots.

Energy Dispersive X-Ray (EDX), Total Reflection X-Ray Fluorescence (TXRF), X-Ray Diffraction (XRD) and Infrared (IR) microscopy analysis is presented in order to show results on the compositional, crystallographic properties, and defect morphology of the $Cd_{1-x}Zn_xTe_{1-y}Se_y$ crystals for various Se compositions.

Atomic Force (AFM) and Electrostatic Force (EFM) Microscopies will also be used on low energy $Ar^+$ ion irradiated samples as this technique has been previously demonstrated [4] to be a powerful tool for analyzing the formation of inclusions and precipitates on $Cd_{1-x}Zn_xTe$ crystals.

**References**

[1] Roy UN, Camarda GS , Cui Y, James RB, X-ray topographic study of Bridgman grown CdZnTeSe, J. Cryst. Growth 546 (2020) 125753.
[2] Rejhon M, Dedic V, Beran L., Roy UN, Franc J, James RB , Investigation of deep levels in CdZnTeSe crystal and their effect on the internal electric field of CdZnTeSe gamma-ray detector, IEEE Trans. Nucl. Sci. 66 (8) (2019) 1952–1958.
[3] Martínez-Herraiz L., Braña AF, Plaza JL Vertical Gradient Freeze Growth of two inches $Cd_{1-x}Zn_xTe_{1-y}Se_y$ ingots with different Se content. J Cryst Growth. 2021;573:126291.
[4] Martínez-Herraiz L, Plaza JL, Electrostatic force microscopy study of the electrical properties of cadmium zinc telluride crystal surfaces after low energy argon irradiation at different substrate temperatures, Nucl. Instrum. Methods Phys. Res. B 516 (2022) 55–67.