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DISTRIBUTION STUDY OF MICRO ALLOY ELEMENTS ON CADMIUM TELLURIDE CRYSTALS BY ICP-MS-LASER-ABLATION TECHNIQUE

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Abstract: *One of the techniques to obtain Cadmium Telluride is achieved thermally from melt grown. Unfortunately for this process micro elements migrate, solidification occurs and this leads to a corresponding variation of all properties*

This paper presents a synthetic study on the development segregation of advanced characterization and highlights the concentration of micro elements in a cadmium telluride macro-crystal. For this purpose we are using a plasma emission spectrometer ICP-MS-Laser-Ablation by which concentrations, from five mm along the symmetry of crystal axis, were determined step by step.

Key words: *cadmium, tellurium, laser, ablation, ICP-MS.*

1. INTRODUCTION

Currently cadmium telluride is a semiconductor material with a widely technique used in solar cells and X-rays and gamma detectors (Brihi, 2007, Fu, 2008, Shieh, 2005, Sochinskii, 2004).

When using solid pills taken from growing crystals great interest should be paid to the distribution of chemical elements composition because this distribution heavily influences all properties from the semiconductor and ending with the mechanical ones (Ivanov-Omskii, 2009, Singh, 2006). The local chemical analysis can proceed in two ways:

- the crystal is sectioned into different areas, mineralized, then the solution is analyzed by atomic absorption spectrometry AAS or atomic emission spectrometry ICP.
- the crystal is sectioned lengthwise and the composition and concentration in well-defined points, located at equal distances on the crystal axis, using ICP/MS- LASER Ablation technique are analyzed.

2. EXPERIMENTAL

In the experimental research was used a macro cadmium telluride crystal whose concentrations and composition of components and mechanical characteristics are presented in table 1.

Study of cadmium telluride crystal was provided by the research team of University of National Semiconductor Yurie Fedkovichi of Chernovtsy - Ukraine.

Elements	V	Cr	Co	Ni	Cu	Zn
% average	**$7.02 \cdot 10^{-3}$**	**$5.96 \cdot 10^{-3}$**	**$1.51 \cdot 10^{-3}$**	**$7.76 \cdot 10^{-4}$**	**$2.24 \cdot 10^{-3}$**	**0.11**
Ga	Ge	As	Se	Br	Cd	In
$6.05 \cdot 10^{-5}$	**$3.26 \cdot 10^{-4}$**	**$1.03 \cdot 10^{-4}$**	**$3.26 \cdot 10^{-4}$**	**$5.36 \cdot 10^{-4}$**	**44.846**	**$2.22 \cdot 10^{-4}$**
Sn	Sb	Te	I	W	Tl	Pb
$2.67 \cdot 10^{-4}$	**$2.22 \cdot 10^{-4}$**	**55,065**	**$3.27 \cdot 10^{-3}$**	**$8.67 \cdot 10^{-4}$**	**$9.10 \cdot 10^{-6}$**	**$2.32 \cdot 10^{-5}$**

Tab. 1 Average concentrations of micro alloy elements from cadmium telluride macro-crystal investigated.

The study is particularly interested in the distribution segregation of micro-alloying chemical elements depending on the geometric position of a point on the length axis of cadmium telluride crystal, distribution that further allows the composition and concentration correlation with semiconductor mechanical and thermal properties of cadmium telluride crystal. For this purpose cadmium telluride crystal was mechanically cut lengthwise after axis, distances from 5 to 5 mm were marked on the axis of symmetry figure 1.

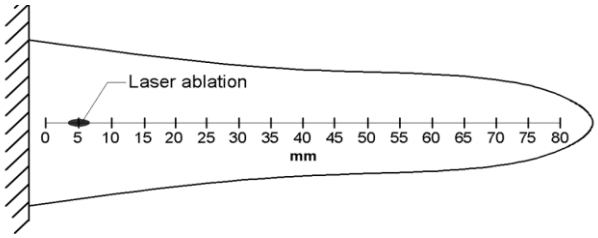

Fig.1 Scheme analysis on areas of the cadmium telluride crystal.

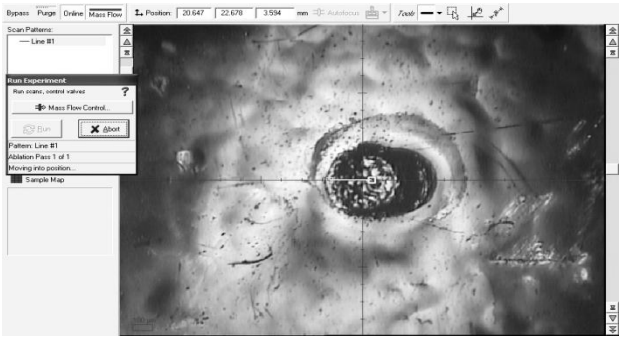

Fig.2. Surface impress of a qualitative and quantitative analysis on an area on cadmium telluride crystal. (NewWave laser ablation with a large beam, 266nm UV Nd: YAG), 80μm channel width, channel length 3500μm. ICP-MS-Agilent 7500 spectrometer.

Atomic vapors resulting from evaporation of the surface layer of cadmium telluride crystal with laser fascicle were placed directly under a slight vacuum in the atomic type emission spectrometer ICP-MS Agilent 7500 equipment from the Instrumental Analysis Laboratory, Food Engineering Faculty within the University of Suceava / Romania**.**

3. RESULTS AND DISCUSSION

The study on distribution of micro-alloy elements on cadmium telluride crystal spread over all the eighteen chemical elements which average concentration (all concentrations mediate the sixteen points of measurement points) is presented in table 1. Figure 3 illustrates synthetic sense of increasing or decreasing the concentration of micro alloy elements on

cadmium telluride crystal axis from the base or from the top of it.

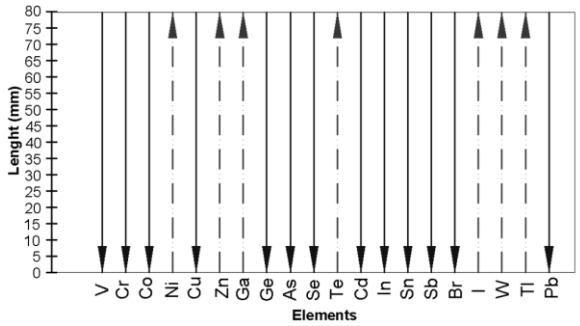

Fig.3. Tendency of increase / decrease the concentration of micro alloy elements on cadmium telluride crystal length from the base or top.

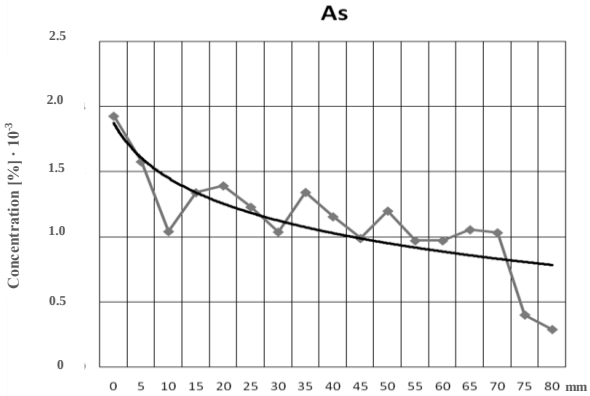

Fig.4. Distribution of Arsenic micro alloy element in cadmium telluride crystal. Average laser energy 425 [mJ], average energy density 8.458 [mJ/cm^3].

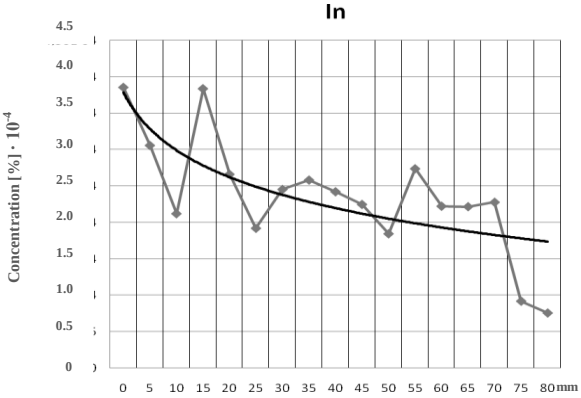

Fig.5 Distribution of Indium micro alloy element in cadmium telluride crystal. Average laser energy 425 [mJ], average energy density 8.458 [mJ/cm^3].

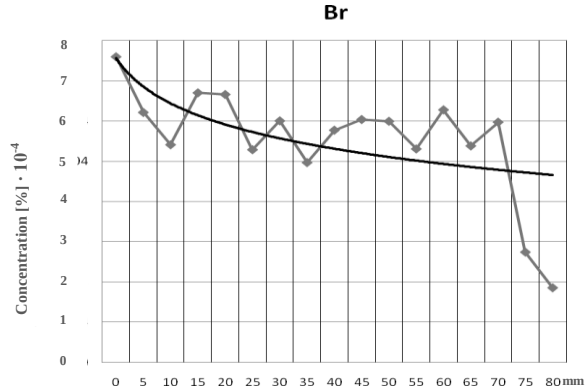

Fig.6. Distribution of Bromine micro alloy element in cadmium telluride crystal. Average laser energy 425 [mJ], average energy density 8.458 [mJ/cm^3].

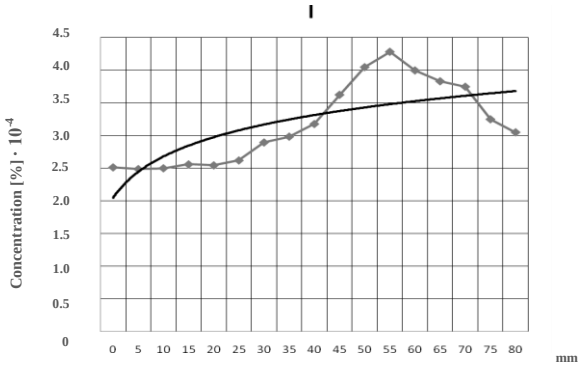

Fig.7. Distribution of Iodine micro alloy element in cadmium telluride crystal. Average laser energy 425 [mJ], average energy density 8.458 [mJ/cm^3].

Actual distribution of concentration for the elements arsenic, indium, bromine and iodine is reproduced in fig. 4, fig.5, fig.6, fig7. We use only four graphs because of space lack and the four pursued elements formed the subject of a specific study on the influence of these factors on the characteristics of the semiconductor cadmium telluride.

4. CONCLUSIONS

An ICP-MS system solution coupled to an infrared laser is optimal equipment for qualitative analysis, quantitative and spatial segregation study distribution of micro-elements in a cadmium telluride crystal. Knowing this distribution represents the correlation of electrical, mechanical and thermal properties of cadmium telluride crystal with specific zonal chemical composition.

5. AKNOWLEDGEMENTS

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