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From 6 June 2016 to10 June 2016 we were visiting Department of Applied Physics, Aalto University, Finland. Our host was prof. Filip Tuomisto head of the Group Antimatter and Nuclear Engineering. His group specializes in the development and applications of positron-based spectroscopic tools in condensed matter research. It also works on reactor and radiation physics research.

In our research we have provided growth and characterization family of CdTe based crystals for X and gamma ray detectors. Control of defects concentration for such materials is very important. One of the main defects in such crystals is Cd vacancies.

The annealing of samples in Cd vapor reduces the conductivity (and increases the resistivity) by three orders of magnitude. We have attributed that effect to the removing shallow acceptor centers created by ionized cadmium vacancies and V_{Cd}^{2-}. Since the number of carriers (holes) decreases, the Fermi level (E_F) moves deep into the energy gap and the semiconductor becomes semi-insulating. Recently another explanation of the semi-insulating properties of discussed material has appeared. It has been suggested that during annealing in the Cd vapor singly ionized cadmium vacancies (V_{Cd}^{-}) disappear, but in their places appear doubly ionized cadmium vacancies, V_{Cd}^{2-}. They should lead to a significant increase in the resistivity, but also an increase in scattering and trapping on the deep levels. Concentration cadmium vacancies could be measured by positron absorption spectroscopy. The detection limit of this method for concentration of negative centers (in our case ionized acceptors) is 10^{15}-10^{16} cm^{-3}. Negatively charged cadmium vacancies trap positrons. Reducing the concentration of vacancies should result in reducing the positron trapping. The change of the singly ionized into the doubly ionized cadmium vacancies should increase the positron absorption. Experiments (because of the method sensitivity) should be performed on a material with the cadmium vacancy concentration, V_{Cd}^{-}, on a level ~ $10^{17}cm^{-3}$. Samples with such a level of cadmium vacancies may be obtain by appropriate annealing. Proper annealing in the Te vapor could increases the concentration of cadmium vacancies V_{Cd} - up to 10^{17} cm^{-3}, or even up to 10^{18} cm^{-3}.

For our visit we have prepared few series of as-grown, Cd annealed and Te annealed samples, cut from different CdTe-based crystals. The samples were measured in room temperature during the traineeship period. These preliminary results were used for samples selection for future temperature dependent measurements.

We are going to continue scientific cooperation between IP PAS and Department of Applied Physics.