Photothermal spectroscopy of $Cd_{1-x}Be_xTe$ mixed crystals

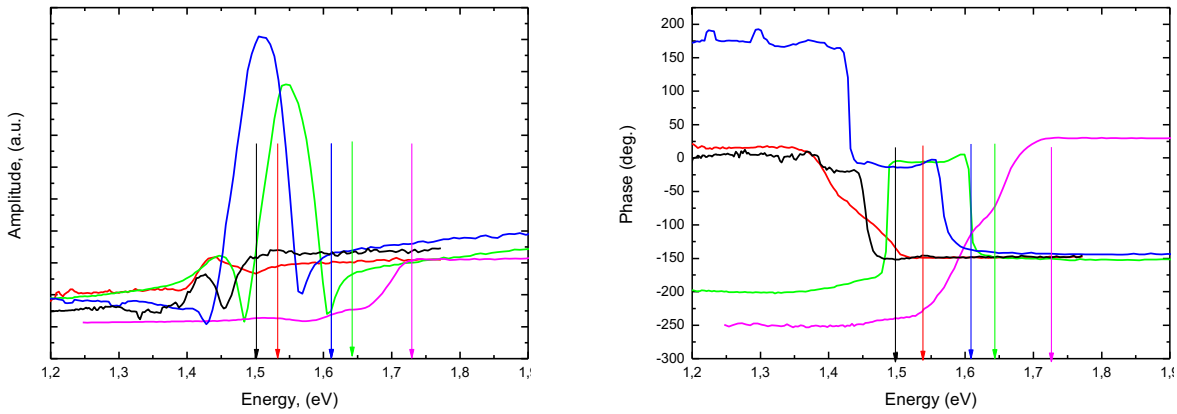
Zakrzewski J(1)*, Marasek A(1), Abouais A(1,2)

(1) Institute of Physics, Nicolaus Copernicus University, ul.Grudziadzka 5/7, 87-100 Torun, Poland
(2) Laboratory of Engineering Sciences for Energy, National School of Applied Sciences of El Jadida, BP 1166, EL Jadida, Morocco

*Corresponding author's email: jzakrzew@umk.pl

Cadmium telluride-based materials are still promising as materials for x-ray and γ-ray detectors [1,2]. An important problem is to find the best substituting atoms with optimal composition in the matrix of CdTe crystal. The potential candidate to incorporate CdTe is Be atom. The mixing of the compounds during the growth procedure gives the possibility to change electronic and thermal properties, lattice parameters, and bandgap energies.

The paper shows the application of piezoelectric photothermal spectroscopy to determine the energy gap values for different beryllium content and the influence of the surface preparation on the character of the amplitude and phase piezoelectric photothermal spectra.



a) b)

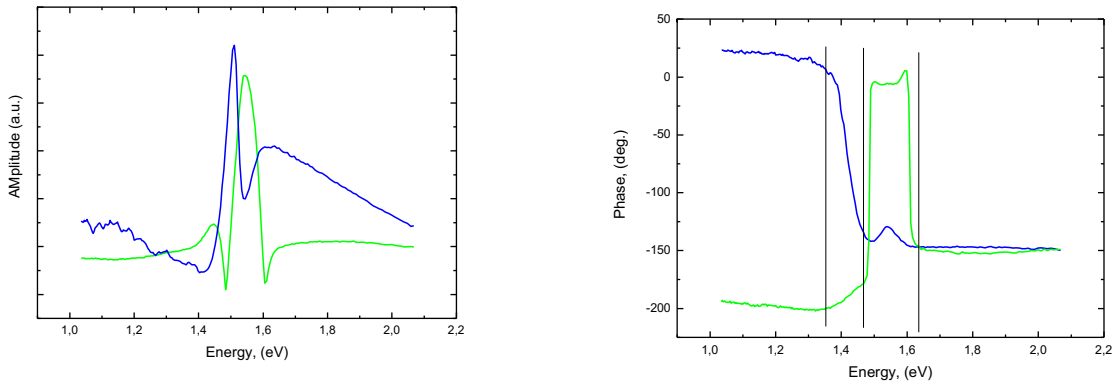
Fig. 1. Amplitude **(a)** and phase **(b)** spectra of $Cd_{1-x}Be_xTe$ for different beryllium content in rear configuration mode, black line – x=0, red – x=0.01, blue- x=0.03, green – x=0.05, magenta – x=0.1. The colour arrows indicate the values of energy gaps.

The rear and front configurations were used in the investigations. They are associated with the geometry of the sample and a detector position. At the rear configuration, the sample is irradiated from one side, and the detector is located on the other (non-illuminated); at the front one, a detector is located at the illuminated surface. As the theory shows, each of these configurations could give a different character of the amplitude and phase spectra [3].

The investigated crystals were grown by the high-pressure Bridgman method under argon overpressure. The crystals were cut into 1-1.2 mm thick plates and mechanically grounded, polished, and chemically etched.

The proper method of surface treatment of the material is essential for the device quality, and the piezoelectric photothermal method gives the possibility to choose and evaluate the appropriate one [4].

For semiconductors, there are three main sources of photothermal signal: thermal, plasma waves (associated with diffusion and recombination of carriers). In the investigation of transport in semiconductors, one can also take into account the immediate thermalization of carriers and nonradiative surface recombination. Their influence on the character of amplitude and phase piezoelectric spectra is shown and discussed.



a) b)

Fig. 2. Amplitude **(a)** and phase **(b)** spectra for the ground (green lines) and etched (blue lines) $Cd_{0.95}Be_{0.05}Te$ sample.

References

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