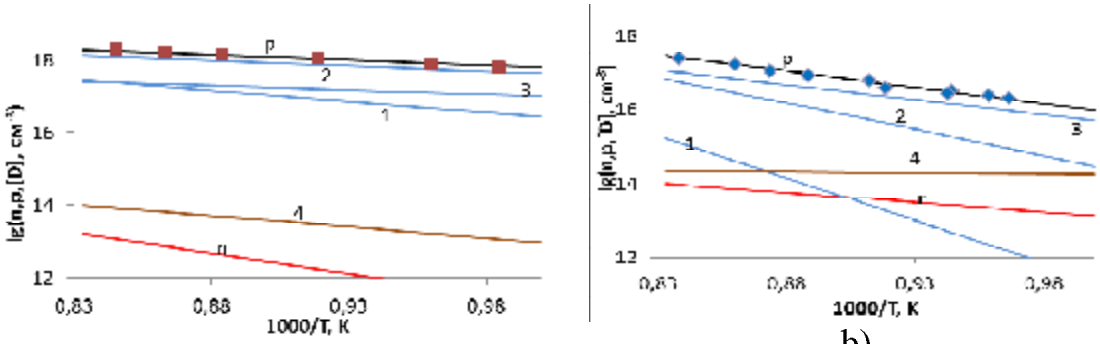
Thermodynamics of Point Defects and Their Electrical Activity in ZnTe Crystals

Horichok I.V., Pylyponiuk M.A., Freik N.D.

Vasyl Stefanyk Prekarpathian University, Ivano-Frankivsk, Ukraine

Zinc telluride (ZnTe) is a relatively little studied direct band gap semiconductor and is of interest in terms of the expansion of element basis of modern electronics [1]. Also, as a direct band gap semiconductor, ZnTe has high photosensitivity and can be successfully used for efficient solar energy conversion [1]. Its effective practical use depends on the defective subsystem.

In this paper, the predominant type of point defects in the two-temperature crystal annealing process is calculated using the method of thermodynamic potentials. It has been established that under annealing in zinc vapor (P_{Zn} = 13300 Pa) at temperatures T = (1000-1200) K the dominant defects are doubly ionized zinc vacancies, and under annealing in tellurium vapor (P_{Te} = 13300 Pa) in the same temperature range the dominant defects are once ionized zinc vacancies. A close agreement between the formation energy of neutral zinc vacancy that has been calculated in our work and theoretically known values, and a satisfactory correlation of our values of concentration of free charge carriers with experimental data indicate the adequacy of the presented defect subsystem model and of conclusions that have been made on its basis.



a) b)

Fig. The dependence of concentrations of electrons (n), holes (p), point defects ([D]) on temperature T under two-temperature annealing at tellurium vapour (P_{Te} = 13300 Pa) (a) and zinc vapour (P_{Zn} = 13300 Pa) (b). (1 – , 2 – , 3 – , 4 –). Solid curves are calculation; points are experiment [2].

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1. A. Sakalas, Z. Yanushkevichyus, “Point defects in semiconductor compounds”. Nauka, Moscow, p.153, 1988.
2. F. T.J. Smith, “High temperature study of native defects in ZnTe” J. Phys. Chem. Solids, Vol. 32, pp. 2201 - 2209, 1971.