Variation in Hall Coefficient with E-M Field of ZnTe Thin Film prepared by vacuum evaporation

Dr. Vaibhav Jain
Deptt. of Physics, D.A.V.(P.G.) College, Bulandshahr, UP, India.

Thin film of ZnTe was prepared by vacuum evaporation method. The variation in Hall coefficient R_H of prepared thin film was recorded with electromagnetic field of different frequencies (2-20 MHz at 2 MHz, steps) and of 5mV, and l0mV amplitudes. The statistical analysis of obtained data was done by R-software which showed that the value of Hall coefficient decreases significantly with increment in frequency of E-M field.

Keywords: Vacuum evaporation method, Hall coefficient, R-software.

1. INTRODUCTION

To meet up the requirements of energy for world, solar energy is the ultimate answer, and this energy can be harvested using solar cells made by thin films of optically active materials, such as ZnTe. Thin films of ZnTe can be prepared by various methods [1] and their properties were studied [2-8] earlier. In reference to solar eruption and its effect on solar cells here we studied the effect of electromagnetic field on Hall coefficient of thin film of ZnTe.

2. EXPERIMENTAL DETAILS

Pure ZnTe in powdered form was taken to produce thin film. A Hind Hivac Vacuum System (model 12A4) was employed for fabrication of thin film in the present investigation. Since here specimen was in powdered form, we used boat of quartz tube of 1/2 inch depth, which was placed in cone shaped tungsten coil. Tungsten strips of 10 cmx0.5 cmxO.05 cm were taken and twisted into a cone like shape at the middle and the two ends of 2.5 cm each were left for fixing in the electrode system of vacuum unit.

Glass sheets were used as substrate after proper cleaning. Gold electrodes were formed on substrate such that film between electrodes was 4"xl"and of thickness 0.20 pm. The thickness of thin film was measured with Talysurf instrument (Model Talysurf 10, Taylor-Hobson). Now substrate was mounted on a wooden block and fine copper wires were adhered for the current and Flail voltage contacts on the film by air drying silver paint. We used Keithlay micro-voltmeter (model 150B) to record Hall voltage. The electromagnetic field of frequencies (2-20 MHz) and of amplitude 5mV, 10mV was applied in the direction of flow of electric current and Hall voltage (V_H) recorded and Hall coefficient R_H was calculated accordingly. This data were tabulated and analyzed statistically by using R-software.

3. RESULTS

The values of R_H ('-'ve, x10^{-7} m^3/C) of thin film of ZnTe of thickness t=0.20 μm with frequencies of E-M field of amplitude 5mV are plotted here in Figure 1.

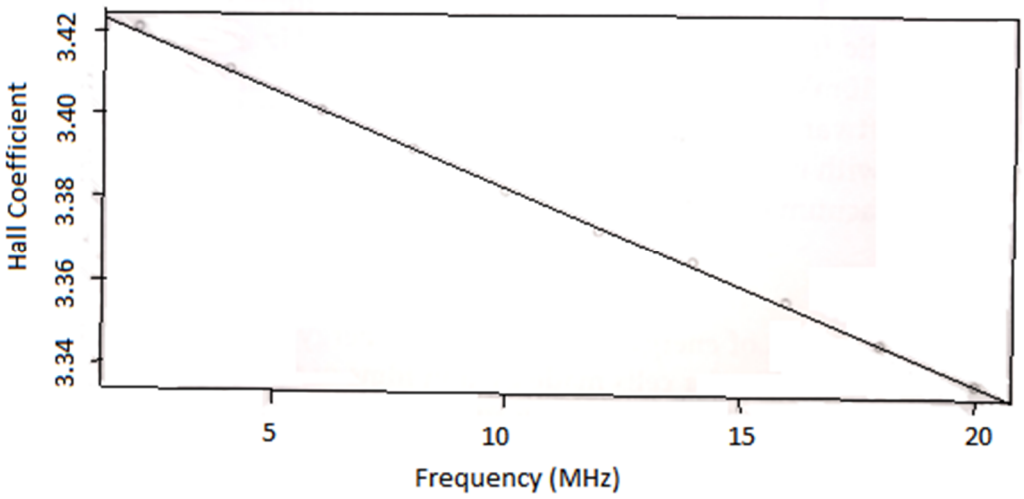

Fig. 1: Variation in Hall Coefficient with frequencies of E-M field of amplitude 5mV.

The values of R_H *('-'ve,* x10^{-7} m^3/C) of thin film of ZnTe of thickness 0.20 μm with frequencies of E-M field of amplitude 10mV are plotted here in Figure 2.

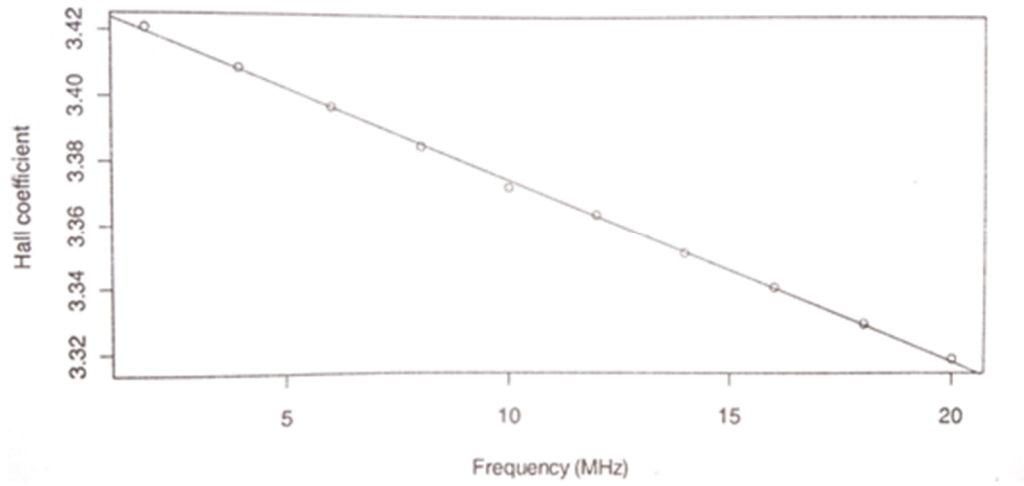

Fig. 2: Variation In Hall Coefficient with frequencies of E-M field of amplitude 10mV.

4. DISCUSSION

From Figure 1 & 2 we see that Hall coefficient R_H decreases with increase in frequency of E-M field and this decrement is more for E-M field of higher amplitude. Besides this the p-value for graph and 2 are 3.397×10^{-13} and 8.33×10^{-14} respectively, which shows that the variation of R_H with frequency is significant. This can be understand as the E-M frequencies passes through the semiconductor, they attenuate charge carriers, so the effective mass of charge carriers decreases and their mobility increases. This effect increases with frequencies and with increase in amplitudes of electro-magnetic field. This results in the increment of effective concentration of charge carriers. Hence value of R_H decreases with increment in frequency and amplitude of E-M field.

REFERENCES

[1] L.Eckerlova; "Physics of Thin Films", 2"d edn., Plenum , New York, 1986.

[2] R.W. Hoffman; "The mechanical properties of thin condensed films", Physics of Thin Films, Vol.3, ed. 13y G. Hass, R.E. Thun (Academic, San Diego), pp. 211, 1966.

[3] C. Winnewisser, P.Jepsen Uhd, M. Schall, V. Schiya and H. Helm; "Electro-optic detection of THz radiation in $LiTaO_3$, $LiNbO_3$ and ZnTe", Appl. Phys. Lett., Vol. 70, pp. 3069, 1997.

[4] R. Sharma, N. Mazumclar and H.L. Das; "Some spectral response characteristics of ZnTe thin films", Bull. Mater. Sci., Vol.29 (1), p. 15-16, Feb 2006.