Effect Of E-M Field On Hall Coefficient Of ZnTe Thin Film

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Thin film of ZnTe was prepared by vacuum evoparation method. The variation in Hall coefficient R_H of prepared thin film was recorded with electromagnetic field of different frequencies (5-15 MHz with 1MHz steps) with 10mV and 15mV 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 ½ inch depth, which was placed in cone shaped tungsten coil. Tungsten strips of 10 cm X 0.5 cm X 0.05 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" X 1" and of thickness 0.30 µm. 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 Hall 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 (5-15 MHz with 1MHz steps) with 10mV and 15mV amplitudes were applied in the direction of flow of electric current 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, X 10^{-7} m^3/C) of thin film of ZnTe of thickness 0.30 µm with frequencies of E-M field of amplitude 10mV are plotted in Fig. 1.

Effect of E-M field of amplitude 10mV on Hall coefficient of ZnTe thin film

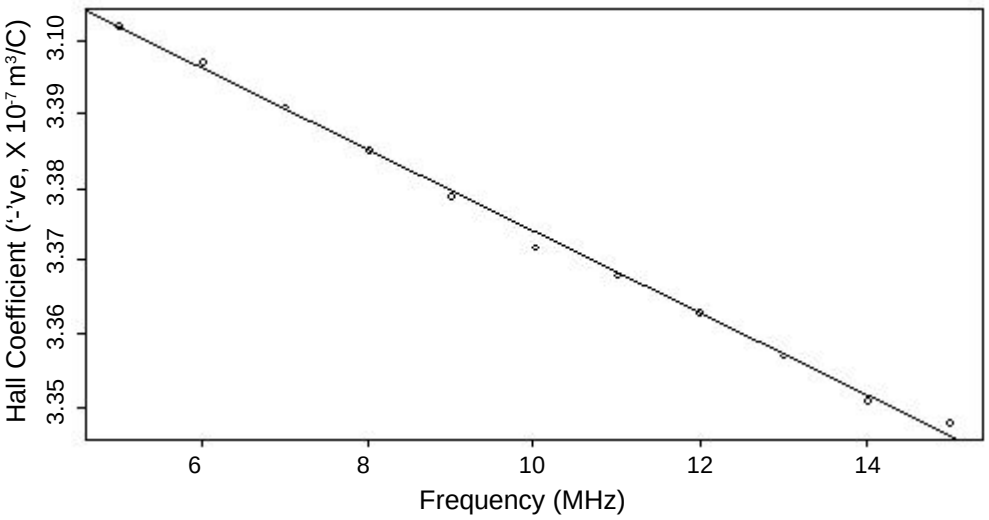

Fig. 1

The values of R_H ('-'ve, x 10^{-7} m^3/C) of thin film of ZnTe of thickness 0.30 μm with frequencies of E-M field of amplitude 15mV are plotted in Fig. 2.

Effect of E-M field of amplitude 15mV on Hall coefficient of ZnTe thin film

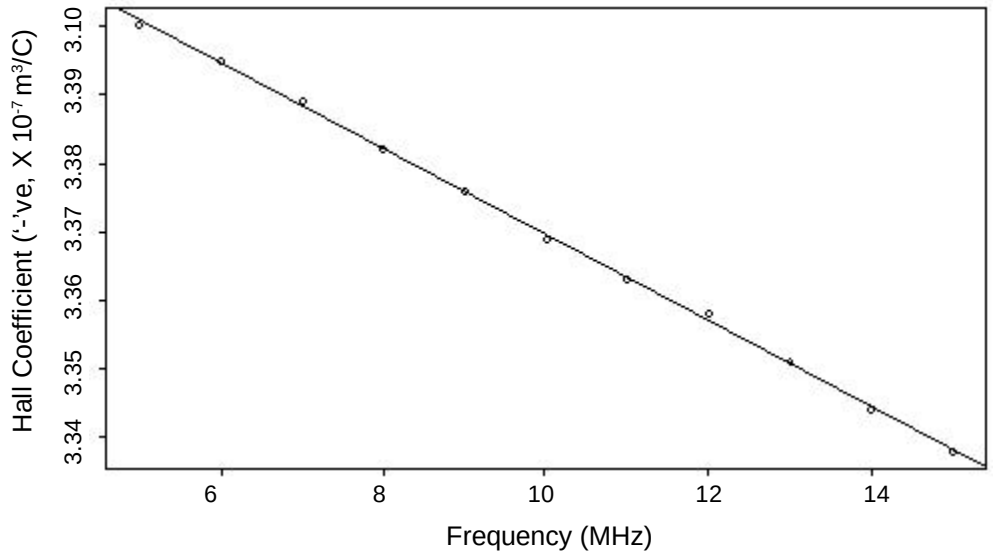

Fig. 2

4. DISCUSSION

From Fig. 1 and 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 Fig. 1 and 2 are 6.787e-13 and 1.792e-15 respectively for 10mV and 15mV, which shows that the variation of R_H with frequency is significant. This can be understood

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. Due to increment in mobility the effective concentration of charge carriers increases. Hence value of R_H decreases with increment in frequency and amplitude of E-M field.

5. REFERENCES

[1] Eckertova L., "*Physics of Thin Films*", 2nd edn., Plenum , New York, 1986.

[2] Hoffman R.W., "*The mechanical properties of thin condensed films*", Physics of Thin Films, Vol. 3, Academic, San Diego, pp. 211, 1966.

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

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

[5] Rusu G.I. et al, "*On the structural and optical characteristics of zinc telluride thin films*", Journal of Optoelectronics and Advanced Materials, Vol. 8, No. 3, pp. 922-926, June 2006.

[6] Kotlyarchuk B., Savchuk V., "*Investigation of ZnTe thin films grown by Pulsed Laser Deposition method*", Physica status solidi. B. Basic research, Vol. 244, pp.1714-1719, September 2006.

[7] Amutha R., Subbarayan A., and Sathyamoorthy R., "*Influence of Substrate temperture on microcrystalline structure and optical properties of ZnTe thin films*", Cryst. Res. Technol., Vol. 41, pp. 1174, 2006.

[8] Pattak Jayadev, Sawant Shilpa N., Nagaraja M., Shashank N., Balakrishna K. M., Sanjeev Ganesh and Mahesh H. M., "*Structural Optical and Electrical Properties of Vacuum Evaporated Indium Doped Zinc Telluride Thin Films*", Int. J. Electrochem. Sci.,Vol. 4, pp.369-376, 2009.