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SOME STUDIES ON SILICON AMPLIFIER TRANSISTOR USING A He-Ne LASER

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ABSTRACT :

In this work a silicon (High β) transistor BC- 109 has been used to study the properties of silicon as a detector. The silicon transistor BC- 109 was cut at its top and made ready for illumination with Helium-Neon Laser (Make-Spectra laser, 0.50 watt). The output from the emitter-base or base-collector electrodes were fed to an amplifier and oscillator circuit, finally connected to a loud speaker of impedence 3 ohms. The output was accurately measured. The intensity of laser beam was varied in small angles. The curves obtained for different illumination intensities provides a deep view in ascertaining the properties of doped silicon.

KEYWORD : Laser beam ,doped silicon, Oscillator circuit, illumination intensities, base-collector electrode.

INTRODUCTION:

Silicon is an important semiconductor for electronic industry used in the manufacture of large number of electronic devices. The study of the effect of illumination on doped silicon material with irradiation from different wavelengths is important to understand the .detecting properties of silicon. Further the use of Laser for the purpose of illumination adds to its advantage of single wavelength. Hence in the present investigations the silicon material is obtained in the form of silicon chip from a high β, transistor itself. Further the combination of different doped materials, p and n, yields different photovoltages depending upon their carrier concentration and doping. Such studies are important to clarify the detecting properties of silicon as a whole.

EXPERIMENTAL DETAILS:

Silicon NPN transistor BC 109 was choosen for the present investigations. The transistor is useful in the fabrication of a low-noise amplifier. Further its common emitter circuit yields high value of β in operations. To obtain doped silicon material this transistor was cut at its top and washed with benzene to make it free from packing materials. In this way the silicon material from the transistor itself becomes capable of ready exposure through concentrated light. A Helium-Neon laser beam was passed through a polariser and then an analyser and was converged on the transistor material. (Fig. 1) The two transistor terminals in emitter base and base collector combinations were selected for separate experimental parts. One of these two terminals were connected to an audio amplifier and oscillator circuits through a suitable loudspeaker. The output meter was kept at the two loudspeaker terminals so that simultaneous recordings of sound and output voltage could be measured. The analyser angle was changed in small regular steps so that the intensity of illumination at the silicon material junctions in the transistor changes; this change produces change in the photo-voltage

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developed across PN combination which could be recorded by the output meter and sound signals. The experiment was repeated with other two terminals of the transistor and corresponding photovoltages were measured through the whole analyser cycle.

RESULT AND DISCUSSIONS:

The result of this study on the illumination of the silicon junction yields the variation of photovoltages with intensities of varying laser beam through analyser angle cycle for different transistor electrodes combinations (Fig. 2 and 3). Two minimas and two maximas are observed in one complete cycle. The peaks are almost of the more or less same value. Variations are regular and smooth. Both these sets of curves for different electrode combinations show minimas at analysing angles of around 130° and 310° . Further the maximas are around 30° and 210° . Thus the detecting properties of silicon for the He-Ne laser beam are obtained by this technique.

CONCLUSION:

The aim of the present paper is to indicate the importance of Laser induced sensitivity of doped silicon studying with transistor, as this is the additive feature for design, operation, performance and reliability of the important material silicon. The response of the material silicon to He-Ne laser light is a convincing fact and further researches are necessary in this direction both from theoretical and experimental point of view /1/.

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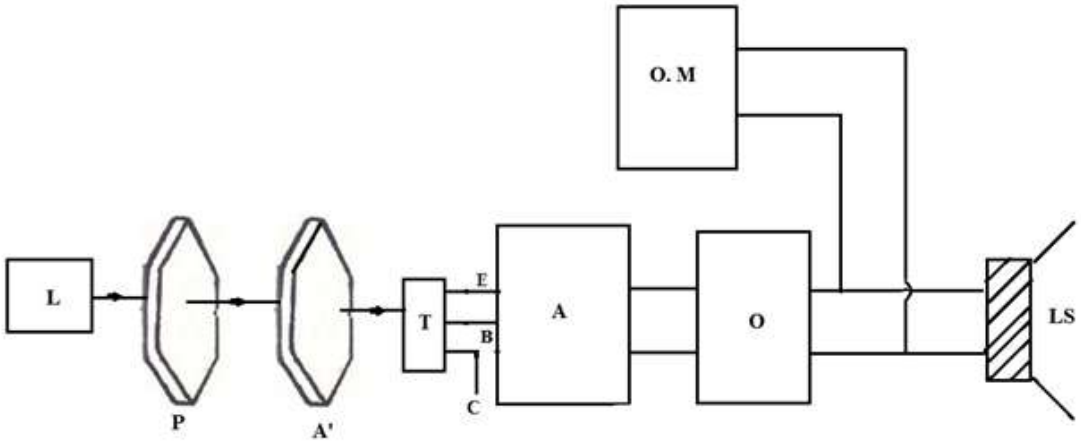
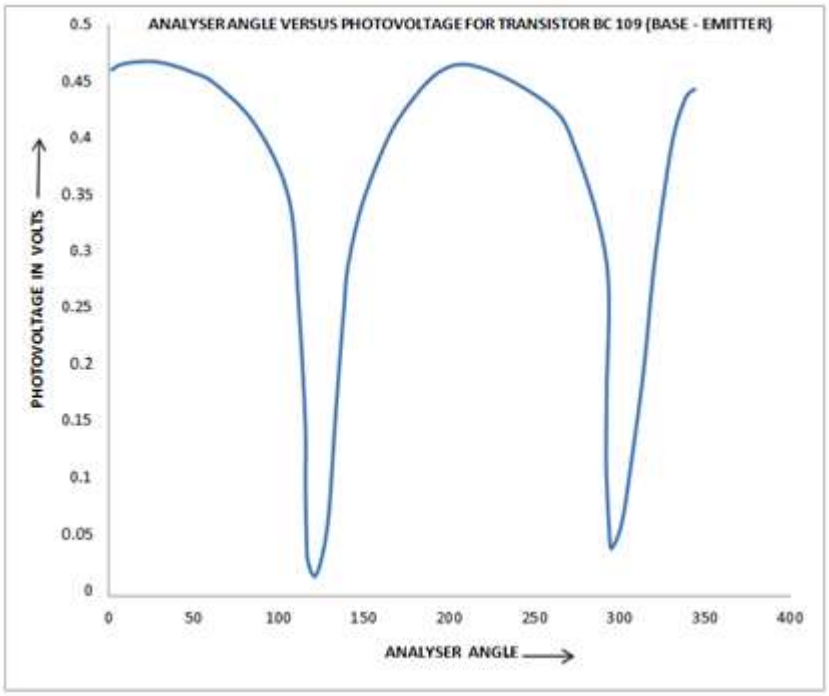
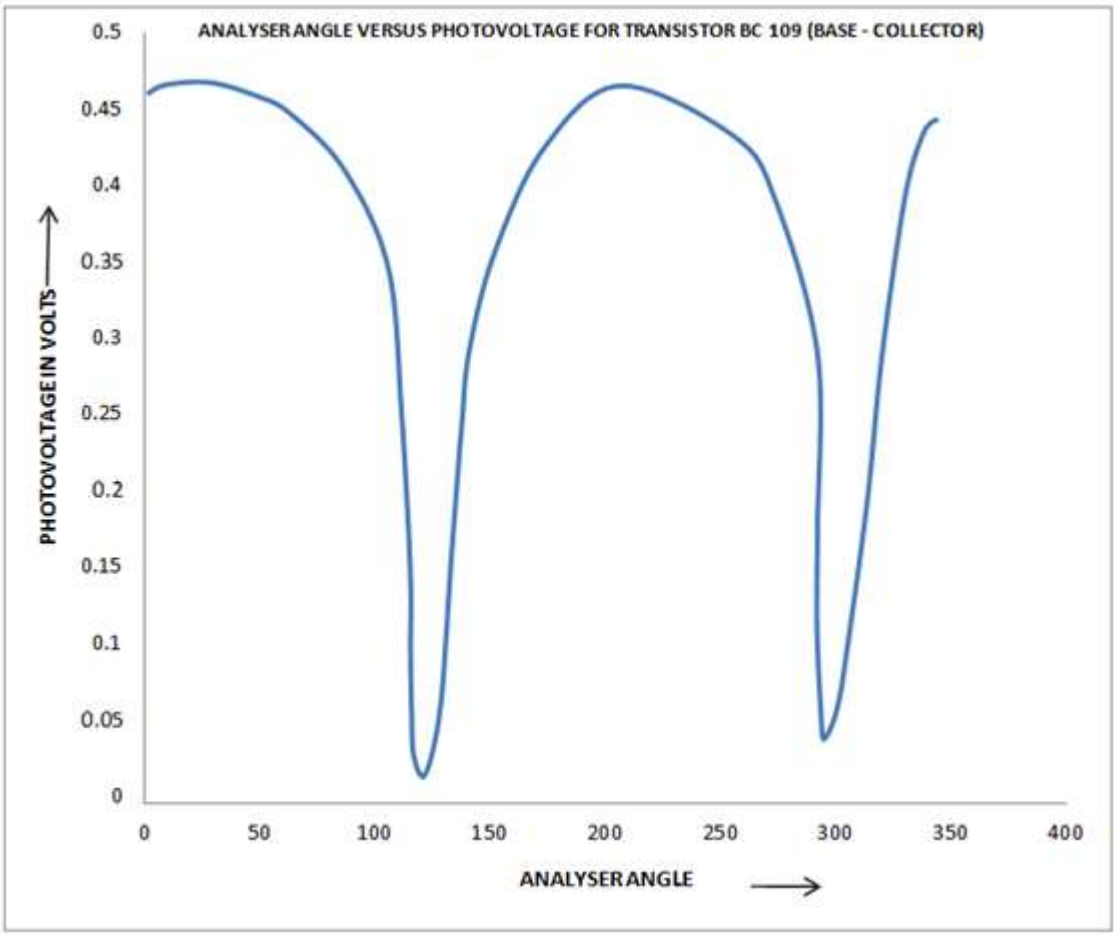


Fig :- L - Laser , P -Polariser, A' - Analyser, T - Transistor, A - Amplfier, O - Oscillator, L.S- Loud Speaker, O.M- Output Meter




ANALYSER ANGLE VERSUS PHOTOVOLTAGE FOR TRANSISTOR BC 109 (BASE - COLLECTOR)
PHOTOVOLTAGE IN VOLTS
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
50
100
150
200
250
300
350
400
ANALYSER ANGLE