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Determination of Energy Gap of a Semiconductor Using Simple Electric Circuit

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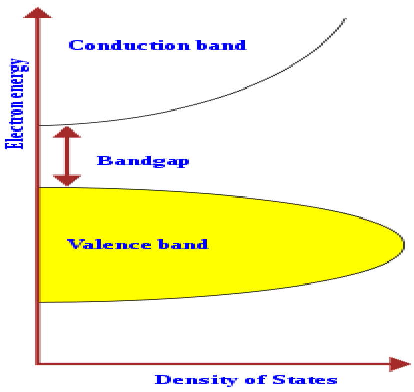
ABSTRACT
In this work and experiment was carried out in order to find the value of energy gap of silicone, zener and light emitting diode (LED) diode using simple electric circuit.

Introduction

In solid-state physics, a **band gap**, also called an **energy gap** or **band gap**, is an energy range in a solid where no electron states can exist. In graphs of the electronic band structure of solids, the band gap generally refers to the energy difference (in electron volts) between the top of the valence band and the bottom of the conduction band in insulators and semiconductors. It is closely related to the HOMO/LUMO gap in chemistry. If the valence band is completely full and the conduction band is completely empty, then electrons cannot move in the solid; however, if some electrons transfer from the valence to the conduction band, then current *can* flow Therefore, the band gap is a major factor determining the electrical conductivity of a solid. Substances with large band gaps are generally insulators, those with smaller band gaps are semiconductors, while conductors either have very small band gaps or none, because the valence and conduction bands overlap [1, 2, 3, and 4]



Semiconductor band structure.

Experimental Setup

The device used in this experiment was analog lab. Voltage generator, resistance of 390 Volt, voltmeter, ammeter, (silicone diode/zener diode/ light emitting diode (LED)) and connecting wires.

The electric circuit was connected in series as follow: the voltage generator and (silicone/zener/(LED) diodes) in turns to the resistance (390 Ω) ammeter and voltmeter to take the values of current and voltage when voltage values change from the source. Different voltage values were taken from the source and readings were taken from the ammeter and the voltmeter, for the semiconductor components in turns.

Table 1. Relation between voltage and current for the silicone diode

Volt (V)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Current (I) mA	0	0	0	0	0.4	0.6	1.0	5.5	12.0	19.9

V Vs. I

1 cm ≡ 0.2 Volt

1 cm ≡ 5 mA

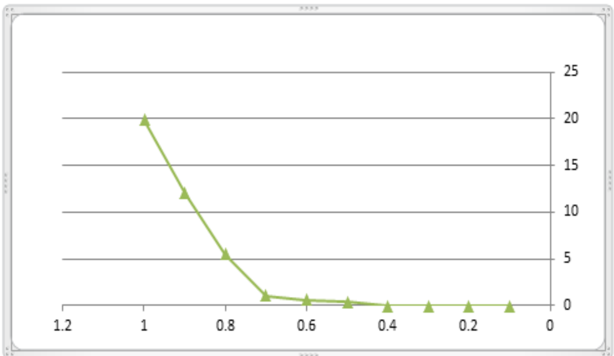


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Table 2. Relation between voltage and current for the zener diode

Volt (V)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Current (I) mA	0	0	0	0.5	1.0	2.5	4.5	6.7	8.6	10.0

V Vs. I

1 cm ≡ 0.2 Volt

1 cm ≡ 5 mA

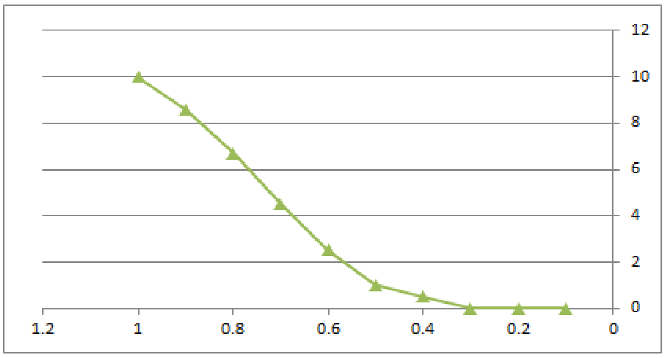


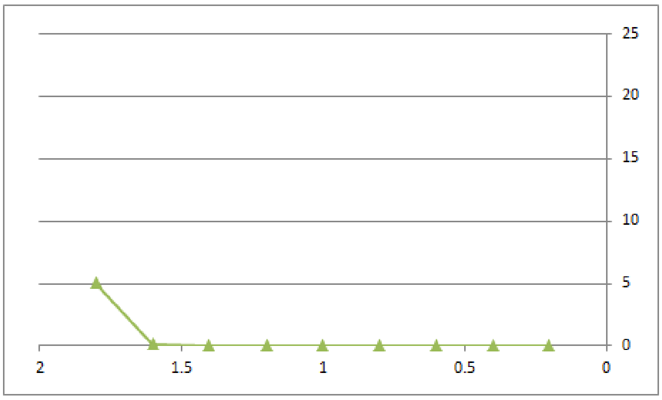
Table 3. Relation between voltage and current for LED.

Volt (V)	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
Current (I) mA	0	0	0	0	0	0	0	0.1	5.0	20.0

V Vs. I

1 cm ≡ 0.2 Volt

1 cm ≡ 5 mA



Discussion

In viewing the three charts of table (1, 2 and 3) it is clear that the current at the silicone diode increases suddenly when the voltage value was 0.5 volt, the same thing was observed for the zener diode when the voltage value was 0.4 volt, and the current increases as well for the (LED) when the value of the current was 1.6 volt.

This voltage value is related directly to the energy gap and the potential barrier.

Conclusion

This simple way the eregy gap can be found and also the same simple technique can be used to find Boltzmann Constant; form the relation between current and voltage. Also this simple technique can be compared to other ways of calculating the energy gap.

References

1. H. Unlu (1992). "A Thermodynamic Model for Determining Pressure and Temperature Effects on the Band gap Energies and other Properties of some Semiconductors". Solid State Electronics 35 (9): 1343–1352. Bibcode: 1992SSEle...35.1343U. doi:10.1016/0038-1101(92)90170-H.

2. Temperature dependence of the energy band gap. Ece-www.colorado.edu. Retrieved on 2013-04-03.

3. Evident Technologies". Evidenttech.com. Retrieved on 2013-04-03.

4. Nan scale Material Design. Nrel.gov. Retrieved on 2013-04-03.