FYSC23

Semiconductor lab

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Abstract

Contents

1 Introduction

Semiconductors are becoming more and more important for our society. One important application of semiconductors is light emitting diodes (LEDs) [1] which are used in e.g. displays and lighting, but also have application in medicine. LEDs also show a much better efficiency than earlier lightbulbs, thus decreasing energy consumption [1], something which is becoming increasingly more important. The basic part of the LED, the pn-junction, is also used in solar cells and can be used to produce energy from light [1].

2 Theory

2.1 Bandgap

The bands in solid state materials are energy continuum that arises in solid state materials due to the number of atoms close to each other [1]. The valance band is the highest band under the Fermi energy and where the electrons are bound to the atoms. The conduction band is the lowest band above the Fermi energy, and where electrons can move freely [1]. The bandgap is the energy difference between the valance band and the conduction band and can be used to describe different materials. For conductors the bandgap is zero and electrons are free to move, for insulators the bandgap is large and a lot of energy is needed to excite an electron from the valance band to the conduction band, and for semiconductors the bandgap exist but is smaller than for insulators [1]. The definition of the size of the bandgap for insulators and semiconductors is a bit arbitrary, but is usually said to be around 3 eV [1].

2.2 Semiconductors

2.3 Doping

2.4 Pn-junction

2.5 LED

3 Experiment

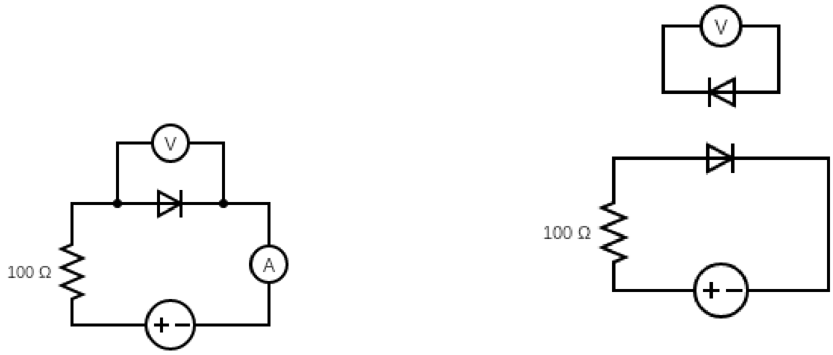
Main goal: explain what you did with enough detail so the reader could reproduce it Include the equipment used, quantities you measured (if relevant also the accuracy of the equipment), procedures you followed Diagrams (e.g. scheme of the circuit) can be included Please do not include results here!

3.1 Part 1

During the first part of the lab we measured the intensity for a white diode with different voltages. The white diode was a violette diode, covered in phosphorus layer witch emptied a white spectrum. The voltage was controlled through a DC-source shown in Figure 1a. Twelve measurements were taken of

3.2 Part 2

3.3 Part 3



(a) This sktch shows the circuit for part 1 and part 2.

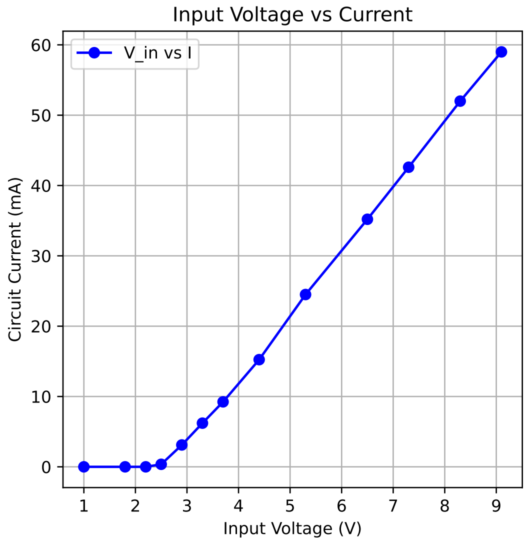
(b) This sktch shows the circuit for part 3, with the two different diodes.

Figure 1: Above one can see the circuits used in this lab. Both circuits used an resistor with $100\,\Omega$.

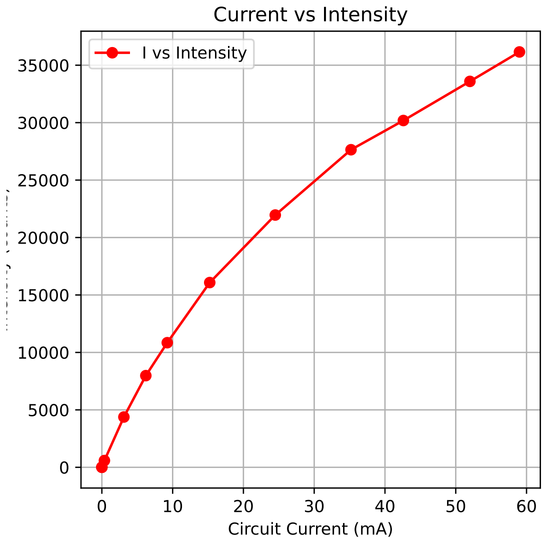
4 Result

4.1 Part 1

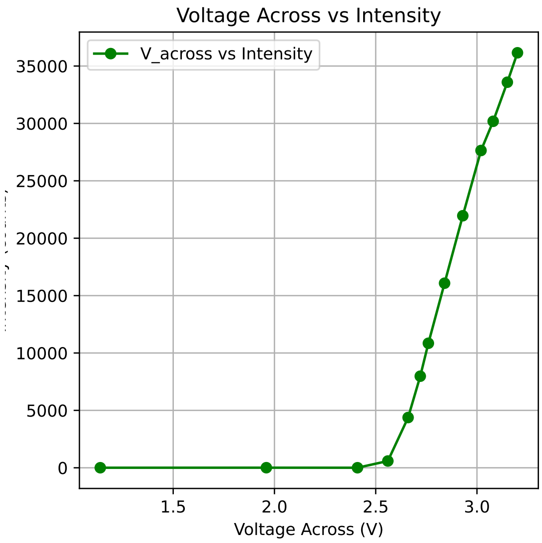
Wavelength white LED: 454.17 nm integration time 70 ms averaging every 10th measurements



(a) Spring



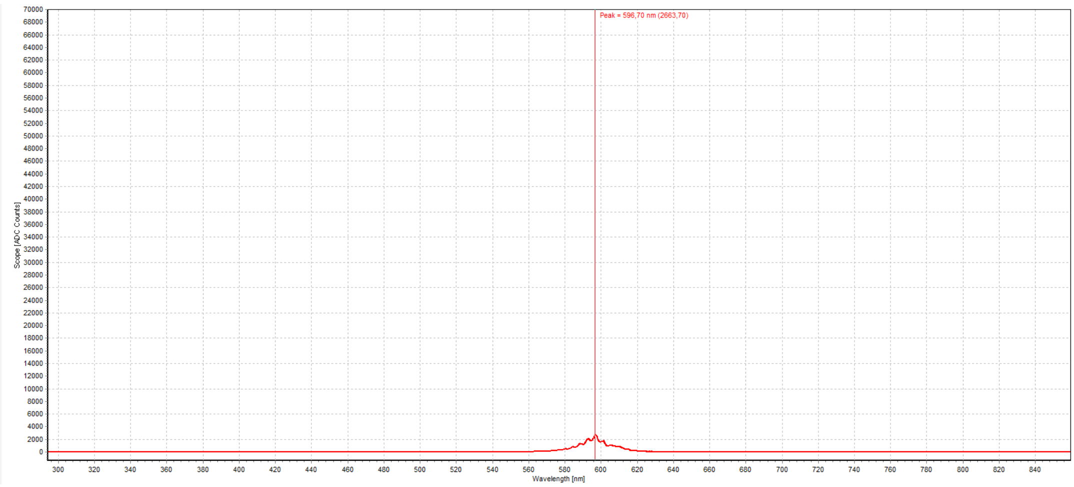
(b) Summer



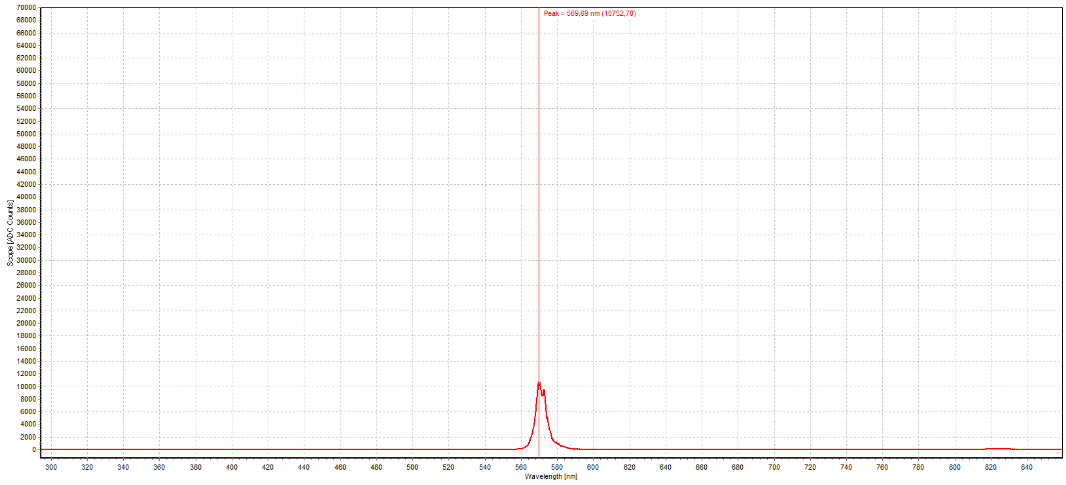
(c) Autumn

Figure 2: Histograms for different seasons.

4.2 Part 2



(a) Spring



(b) Summer

Figure 3: ...

Wavelength white LED: 596.85 nm integration time 2 ms averaging every 10th measurements

Before: V_{in} was 5.0 V, V_{across} 2.06 V, $I_{circuit}$ 30.8 mA and the intensity 2663.70

After: V_{in} was 5.0 V, V_{across} 4.44 V, $I_{circuit}$ 7.7 mA and the intensity 10752.70

4.3 Part 3

Detector/Emitter	Red	Green	Blue
Red	Output	No output	No output
Green	Output	Output	No output
Blue	Output	Output	Output

Table 1: tab:part3

5 Discussion

6 Conclusion

References

[1] Philip Hofmann. *Solid State Physics: An Introduction.* Wiley-VCH, 2nd edition, 2015.