Contents

1 Introduction

12.5%

Describe the motivation for making red LEDs [500 Words max + Figures]

LEDs are more energy efficient than traditional incandescent lighting

Narrow wavelengths.

LEDs can be very small for their optical power.

LEDs can be switched on and off very quickly, this is useful for PWM control for dimmable bulbs.

Televisions

LEDs are cost effective for use on a large scale

The basic function of a Light-Emitting Diode is that two semiconducting layers of types P and N

Longer Lifetime than incandescent

[1]

2 Fabrication

2.1 Cleanrooms

3.125%

Briefly describe why fabrication takes place within a cleanroom. [100 words max]

The clean rooms minimise contamination

there are different scales of cleanroom and so the results from fabrication can be more predictable, e.g. in terms of the likelihood of devices having errors. ¡– is this true?

A cleanroom is a controlled environment

Fabrication of electronic devices takes place in a cleanroom. Cleanrooms are controlled environments where atmospheric conditions are controlled. The class of a cleanroom specifies the number of particles of various sizes for a give volume of air. Guaranteeing the number and size of contamination particles in a fabrication process gives a reasonable approximation as to the feasibility and the probability of success. As devices become smaller, the need for better cleanrooms increases since smaller particles will have a greater effect on the performance and yield of the devices.

2.2 Cleans

3.125%

Briefly describe why we carry out steps 1

2.5 Metallisation

6.25%

What role does our choice of process flow have in the contact formation process? What role does the annealing step have? How have you measured it's effect in your work? [100 words max]

2.6 Lift-Off

9.375%

Describe the concept of the lift-off process, using schematics as required. [150 words max + Figures]

Suggest possible alternative process steps to achieve the same result as obtained in the lift-off process you have used. [50 words max]

3 Test

3.1 Apparatus

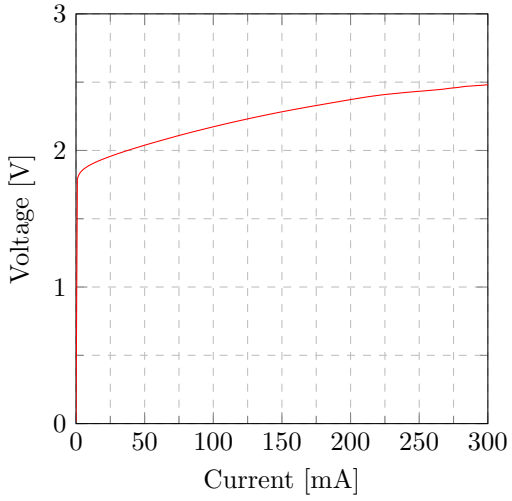
6.25%

Draw a schematic of the test apparatus. Comment upon the power measurement process. [150 words max + Figures]

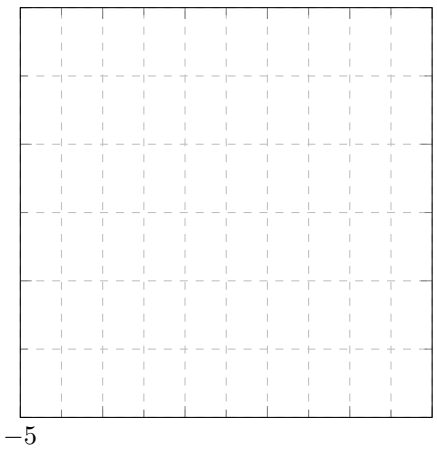
3.2 I-V Characteristics

6.25%

Plot the forward and reverse bias VI characteristics of one of your diodes. Describe the salient features of the graphs [150 words max + Figures]



(a) Forward Current



3.3 LI Characteristics

6.25%

Plot the output light power as a function of forward bias for one of your LEDs (or the standard). Describe the salient features of the graph. [150 words max + Figures].

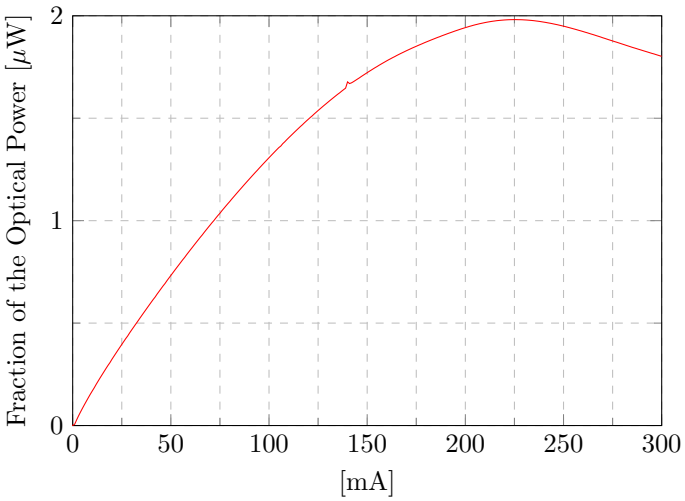
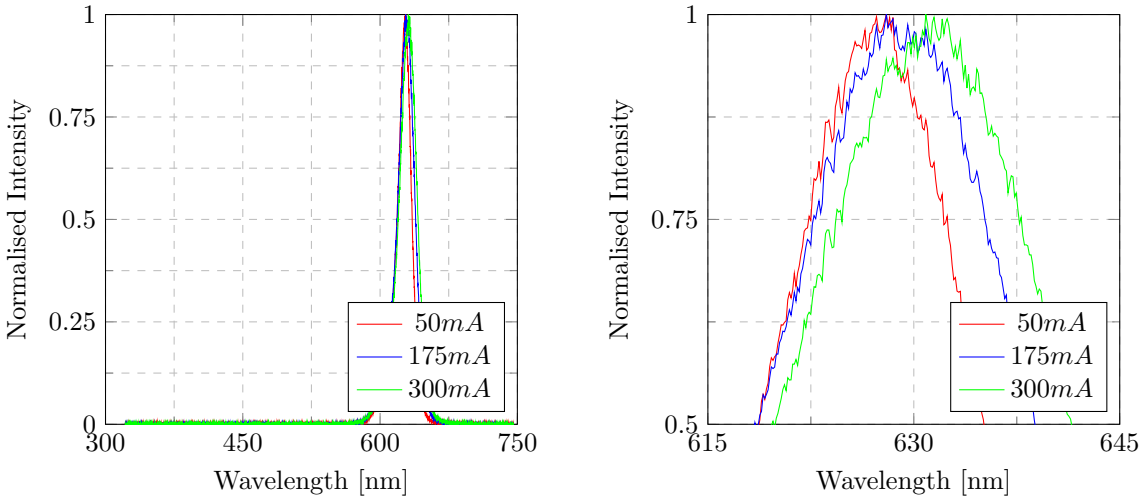


Figure 2: LI Characteristics

3.4 Spectral Characteristics

6.25%

Plot the emission spectra of your device as a function of current. Describe the salient features of the graph, and comment on any relationship to previous plots. Comment upon the collected power, system collection efficiency, and emitted power from the LED. [100 words max + Figures]



(a) Spectral Characteristics

(b) Spectral Characteristics

Figure 3: Spectrum

3.5 Contact Resistance

6.25%

Plot CTLM results for one device from your group. Why do we use CTLMs over TLMs? Describe the salient features of the graph, and comment on any relationship to previous plots. Comment on why only the p-contact is analysed. [150 words max + Figures]

4 Commentary

15.625%

Highlight any process steps that you think may need more attention should you repeat the fabrication process. How would you redesign the process sequence if the scribe and break at process number 8 could be moved to the end? Comment upon how the LED operation varies with mesa diameter. Suggest how you may make the LED operate more efficiently. [300 words max + Figures].

References

[1] A. Einstein, "Zur Elektrodynamik bewegter Körper. (German) [On the electrodynamics of moving bodies]," *Annalen der Physik*, vol. 322, no. 10, pp. 891–921, 1905.

[2] Shipley microposit s1800 series photo resists. [Online]. Available: https://amolf.nl/wp-content/uploads/2016/09/datasheets_S1800.pdf