

EE 535 Lab 1: Introduction to Transmission, Reflection, and Absorbance of Wafers and Thin Films

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Abstract

The band gap of a semiconductor defines its properties. Band gap of semiconductors can be measured by the absorption and reflection of light.

Introduction

Three wafers were loaded into a spectrometer to measure their optical properties. These measured properties allowed for the calculation of band gap and whether the band gap is direct or indirect. The band gap of a material determines its conductivity or in the case of an LED or solar panel what frequency of light it will produce/absorb. Determining if the band gap is direct would inform if any energy is required from the lattice structure whereas indirect wouldn't require this extra energy.

Experimental

In this lab we measured the band gap through measurements of reflection and absorption. These measurements were done with the Cary 5000. This spectrometer works by comparing two slides. This allows to remove influence of the glass on the wafer's absorption and transmission.

Theory

Transmission = T - % of light

Reflectance = R - % of light

Absorbancecoefficient = α

Reflection = Intensity of neglected light

$A = \frac{|I_a|}{|I|}$ For direct Eg $\alpha = (hv - Eg)^{1/2}$

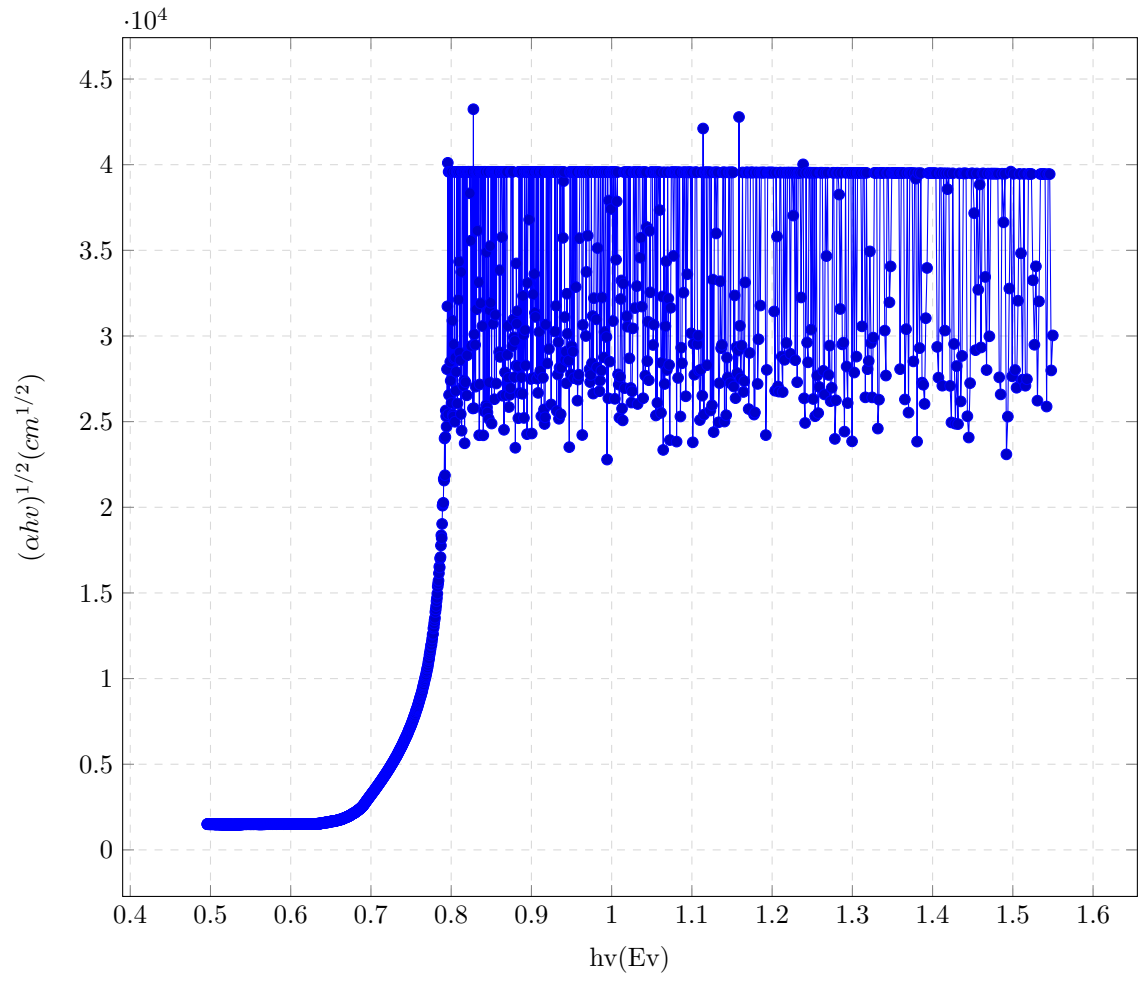
$T = (1 - R^2)e^{-\alpha t}$

$\alpha = (1/t)\ln((1 - R^2)/T)$

These equations were derived from and the provided CSV output files were used inside a python script.

Results

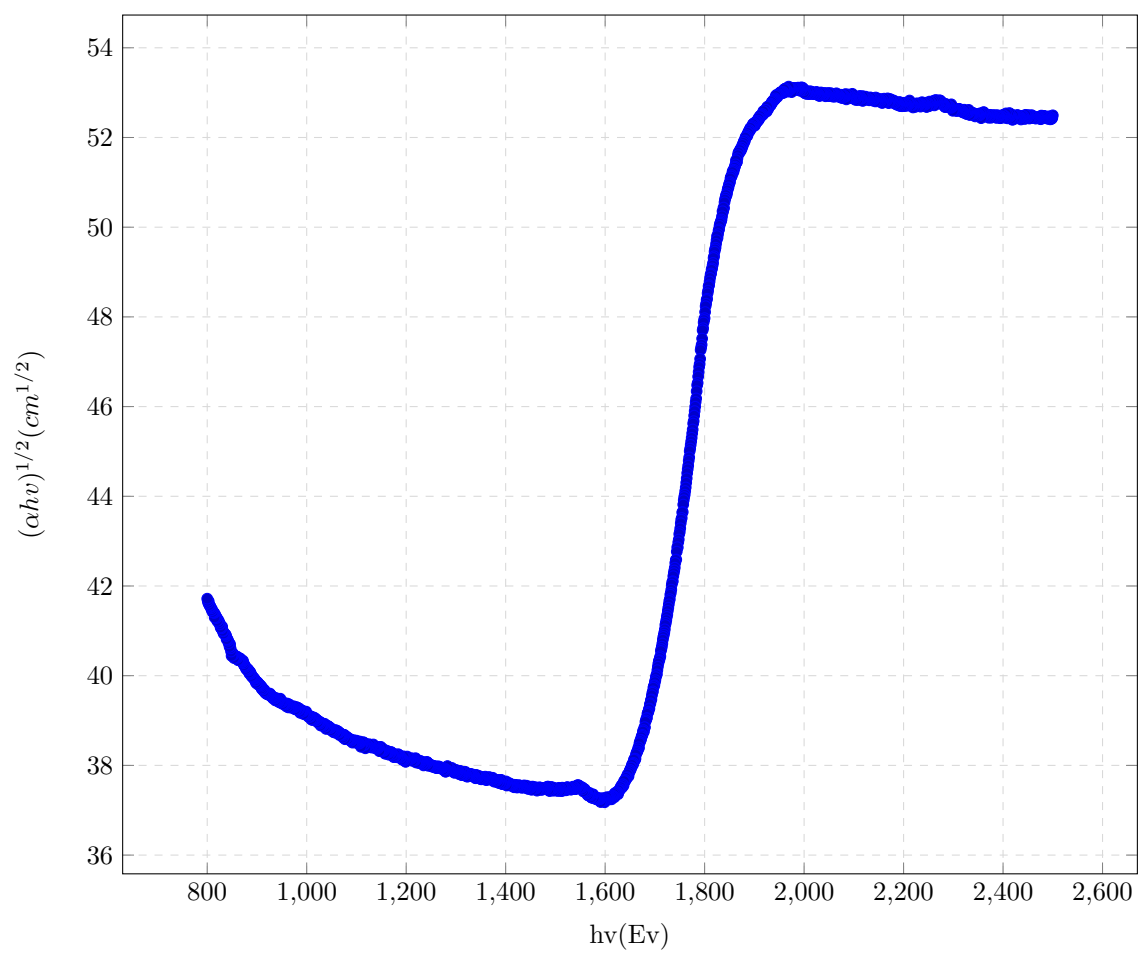
After running the spectrometer there were data points for the three wafers. These datapoints included transmission, reflection, and absorption the following graphs.



Wafer 1 - Tauc Plot

—•— $\alpha = \frac{1}{t} \ln\left(\frac{1 - R^2}{T}\right)$

This plot was created by using the reflection and transmission data to calculate the α of the wafer.



Plot

wafer 1.78 band gap

References

