Microwave Experiment

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Abstract

This is the abstract where you provide a brief summary of the document.

1 Introduction

In this section, you will introduce the topic and provide the background or motivation for your study.

2 Methodology

Here, describe the methods and approaches you used in your research or study.

3 Experimental Apparatus

This section includes the description of the experimental setup and apparatus you used in your work.

4 Results & Discussions

4.1 The IV curve of the crystal

The table below presents the data for $V_{\text{peak-low}}$ and $\frac{1}{4}\lambda$, along with the calculated mean and uncertainties for λ[1].

[1] In this article, the uncertainties consist of both Type A and Type B uncertainties. The total uncertainty is calculated using error propagation.

$V_{\text{peak-low}}$	$V_{\text{peak-low}}$	$\frac{1}{4}\lambda$ (mm)
157	147.5	9.5
147.5	137	10.5
137	124	13
124	113.5	10.5
113.5	101.5	12
101.5	91.5	10
91.5	79.9	11.6

Table 1: Values of $V_{\text{peak-low}}$ and corresponding $\frac{1}{4}\lambda$.

Therefore, the wavelength λ with its total uncertainty is:

$$\lambda = 0.04406\,\text{m} \pm 0.00186\,\text{m} \quad (4.23\%)$$

Then, a relationship between the intensity I and the distance from a node d is measured.

I (νA)	I (A)	d (mm)	$\bar{d}$ (m)
-0.0025	-2.7E-09	136.9	1E-04
-0.0027	1.2E-08	137	0.0011
0.012	3.75E-08	138	0.0021
0.0375	8.58E-08	139	0.0031
0.0858	1.216E-07	140	0.0041
0.1216	1.698E-07	141	0.0051
0.1698	2.264E-07	142	0.0061
0.2264	2.792E-07	143	0.0071
0.2792	3.178E-07	144	0.0081
0.3178	3.54E-07	145	0.0091
0.354	3.636E-07	146	0.01081
0.3636		147.71	

Table 2: Values of $I(\nu A)$, I (A), d (mm), and $\bar{d}$ (m).

If we plot I versus $sin(2\pi d/\lambda_g)$, we found that the result is close to a exponential graph (except the last data).

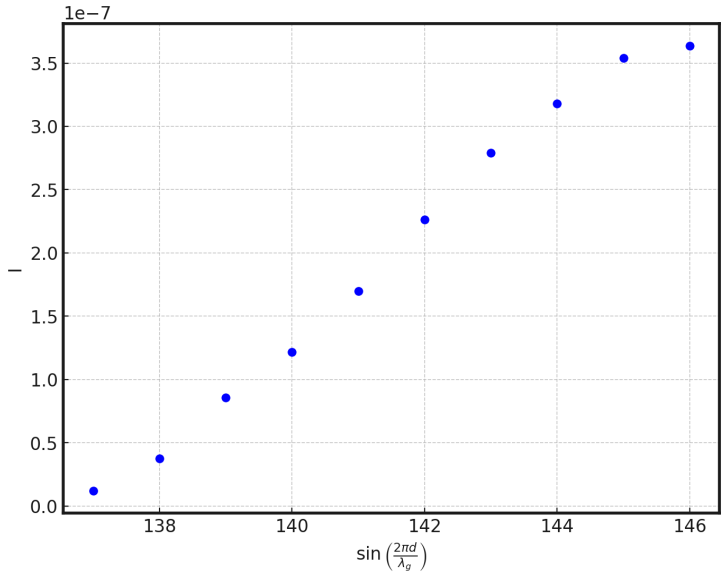

Figure 1: I(A)-$sin(2\pi d/\lambda_g)$ characteristics from the experiment.

Hence, we can guess $I = C \cdot sin(\frac{2\pi d}{\lambda_g})^n$. A linear regression analysis was conducted.

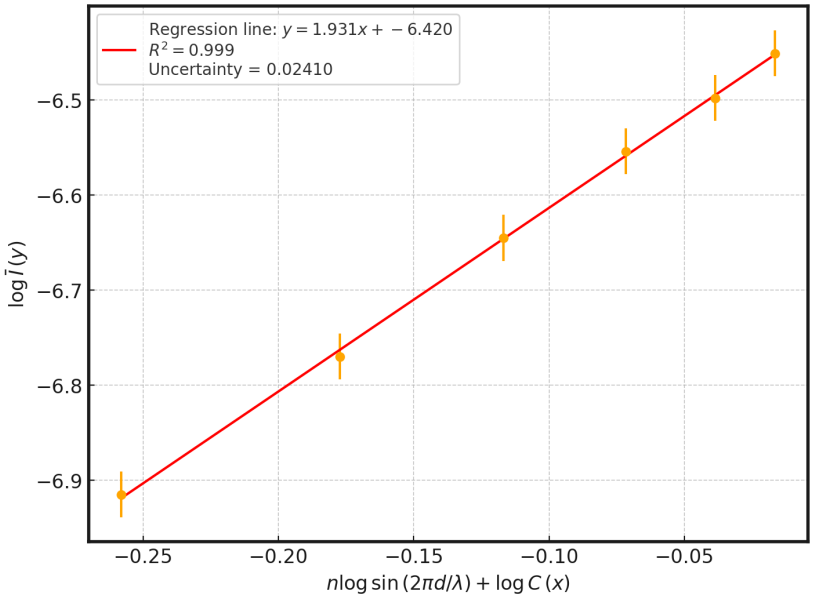

Figure 2: Linear regression analysis of $\log \bar{I}$ vs $n \log \sin(2\pi d/\lambda) + \log C$.

we get:

$$n = 1.931 \pm 0.024 \quad (1.24\%)$$

4.2 the measurement of SWR

We want to calculate

$$S = (\frac{I_{\max}}{I_{\min}})^n$$

Because the length of the apparatus can only allow 4 standing waves, so 8 data points are collected with respect to the wave node and the wave antinode.

$I_{\max}$	$I_{\min}$	$I_{\max}/I_{\min}$
0.3611	0.0033	11.3731
0.3573	0.0036	10.8127
0.3535	0.0034	11.0760
0.3636	0.0035	11.0713

Table 3: Values of $I_{\max}$, $I_{\min}$, and $\frac{I_{\max}}{I_{\min}}$.

we get

$$S = 11.0788 \pm 0.1432 \quad (1.29\%)$$

4.3 The wavelength in a wave guide

For the same reason of the limit of the appatus, 4 points is measured.

Wave bottom	$\Delta\frac{1}{2}\lambda$	λ
154	22	0.044
132	27	0.054
105	21	0.042
84		

Table 4: Values of wave bottom, $\Delta\frac{1}{2}\lambda$, and λ.

Then

$$\lambda_g = 0.04666 \pm 0.00216m \quad (4.63\%)$$

4.4 Permittivity of the dielectric sample and the measurement of tan δ

hahaha

5 Textbook Questions

Here, include any questions from textbooks or exercises that are relevant to your topic.

6 Conclusion

Summarize the main findings and key points from the study.