Report Lab 1

Experimental Physics for AI 2

G, C, D, O

First semester 2024 - 2025

Chapter 1

Measurement of the current-voltage characteristic of a resistor

Chapter 2

Measurement of the current-voltage characteristic of a diode

2.1 Goal

Now we want to measure the current-voltage characteristic of a diode, which should not be linear. Indeed, according to Shockley's law, it is exponential:

$$I = I_0 \left(e^{\frac{qV}{gkT}} - 1 \right)$$

where I_0 is the reverse saturation current, q is the electron charge, k is the Boltzmann constant, T is the temperature, and g is the diode type-dependent constant. In this chapter we will try to verify this law.

Moreover for practical applications it's common practice to define the diode's *threshold voltage* as the voltage at which the diode starts conducting a "significant" current. We will try to measure this value as well.

2.2 Method

Using a similar setup as the one in part one, we recorded the measured values of current at different voltages. The setup is shown in figure 2.1, where the voltmeter is a handheld Fluke multimeter and the ammeter is a Agilent bench multimeter.

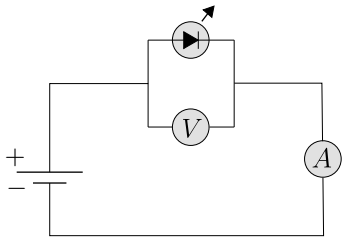

Figure 2.1: Setup of the diode experiment: on the left the diagram showing the circuit made, on the right a photo of the setup

Later, in section 2.4, we will perform various fits to the data to verify the exponential relation and estimate the values of the parameters.

2.3 Data

The data we collected is shown in table and represented graphically in figure 2.2. The bench multimeter for the current measurements had an accuracy of $\pm 0.05\% + 0.05\mu A$ in the $500\mu A$ range; and the handheld multimeter had an accuracy of $\pm 0.5\% + 0.002V$ in the $2V$ range.

Voltage (V)		**Current** (μA)	
0.499	± 0.004	0.03	± 0.05
0.999	± 0.007	0.08	± 0.05
1.499	± 0.009	0.12	± 0.05
1.999	± 0.012	0.16	± 0.05
2.099	± 0.012	0.17	± 0.05
2.200	± 0.013	0.19	± 0.05
2.299	± 0.013	0.26	± 0.05
2.399	± 0.014	1.74	± 0.05
2.409	± 0.014	2.33	± 0.05
2.419	± 0.014	3.16	± 0.05
2.428	± 0.014	4.33	± 0.05
2.438	± 0.014	5.95	± 0.05
2.448	± 0.014	8.19	± 0.05
2.458	± 0.014	11.28	± 0.06
2.467	± 0.014	15.47	± 0.06
2.477	± 0.014	21.16	± 0.06
2.486	± 0.014	28.55	± 0.06
2.495	± 0.014	38.42	± 0.07
2.504	± 0.015	51.03	± 0.08
2.512	± 0.015	66.50	± 0.08
2.520	± 0.015	84.54	± 0.09
2.528	± 0.015	105.8	± 0.1
2.535	± 0.015	130.0	± 0.1
2.542	± 0.015	158.8	± 0.1
2.549	± 0.015	189.2	± 0.1
2.556	± 0.015	222.6	± 0.2
2.562	± 0.015	258.5	± 0.2
2.568	± 0.015	296.5	± 0.2

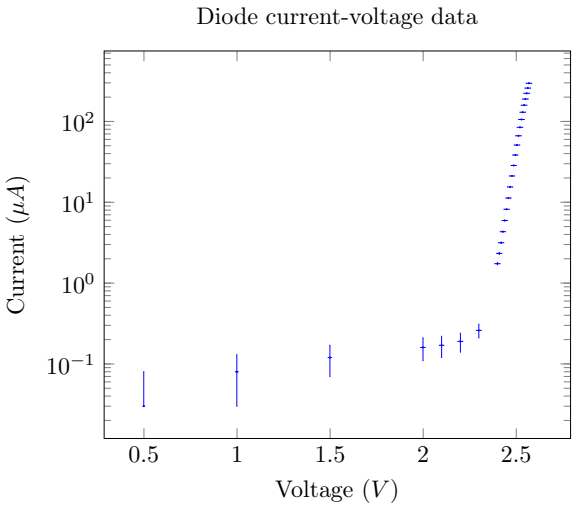

Figure 2.2: Data collected for the diode

2.4 Analysis