EE236 : Electronic Devices Lab
Lab 6 [Tuesday Batch]

Prajwal Nayak (22B4246)

September 13, 2024

1 Aim of The Experiment

1. Part 1 :
   - To plot the forward and reverse bias I/V characteristics of 2 fabricated metal-semiconductor junction diodes (one Schottky contact and another Ohmic contact) using probe station.
2. Part 2
   - To plot the forward and reverse bias I/V characteristics of the given packaged Schottky diode.
   - To obtain the reverse recovery times of a regular PN junction diode and a Schottky diode and compare the two.

2 Part 1

2.1 Circuit Design

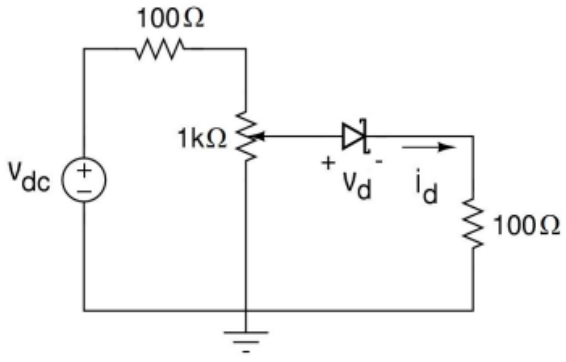
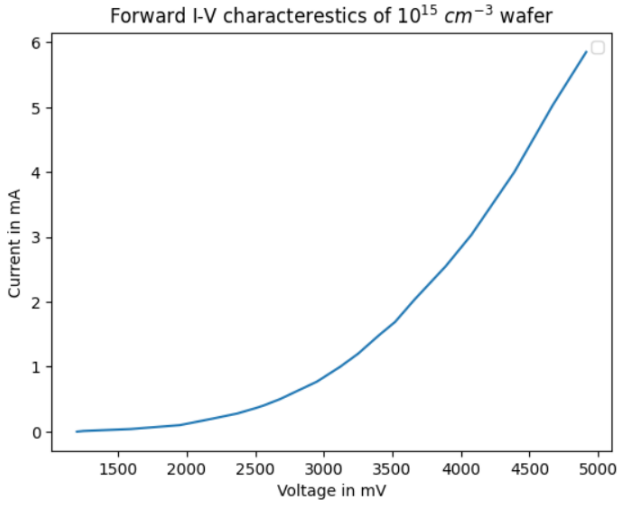
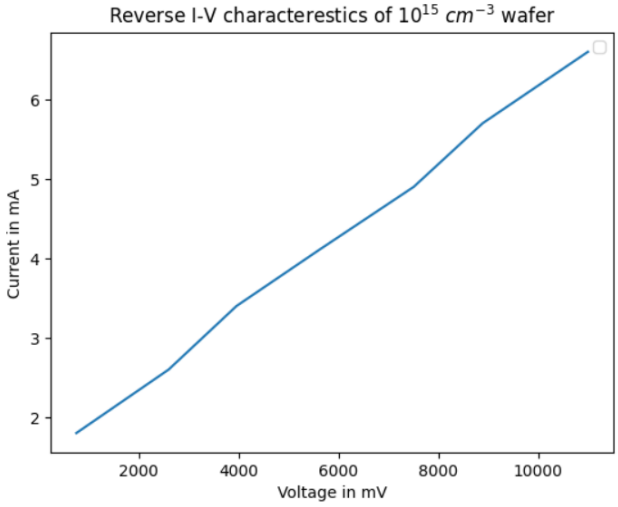
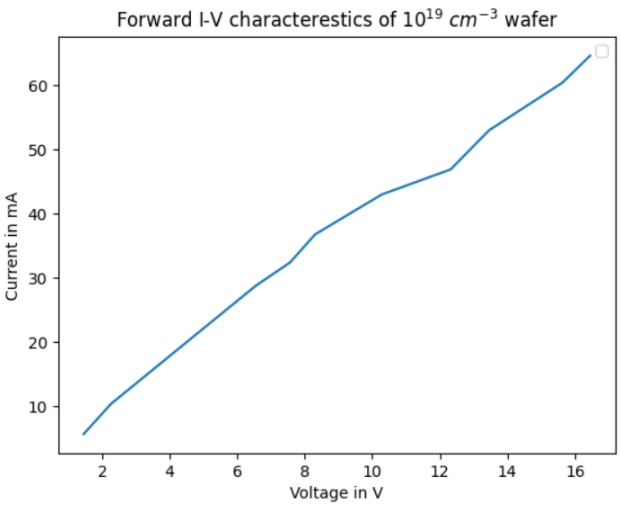


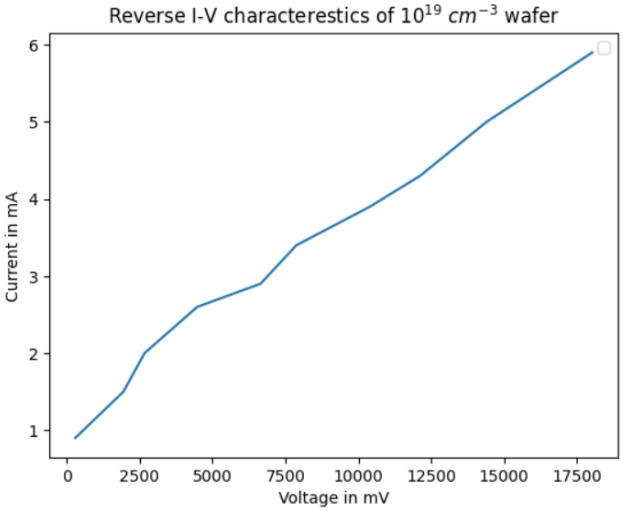
Figure 1: Circuit for I/V characteristics

2.2 Plots









2.3 Calculations, Inferences and Conclusions

1. As doping increases, we see more linear behaviour, which can be explained either as a transition from non-linear to linear I/V characteristics, which seems to be more ohmic in behaviour which shows that there is a transition from semiconductor to metallic behaviour.

2. The wafer with the lower doping($10^{15}cm^{-3}$) is the Schottky diode.

3. **Calculating the built-in voltage V_{bi} and the depletion width W for the schottky diode:** The formula for calculating width once the V_{bi} is known is:

$$W = [\frac{2\epsilon_{Si}}{qN_D}(V_{bi} - V_A)]^{\frac{1}{2}}$$

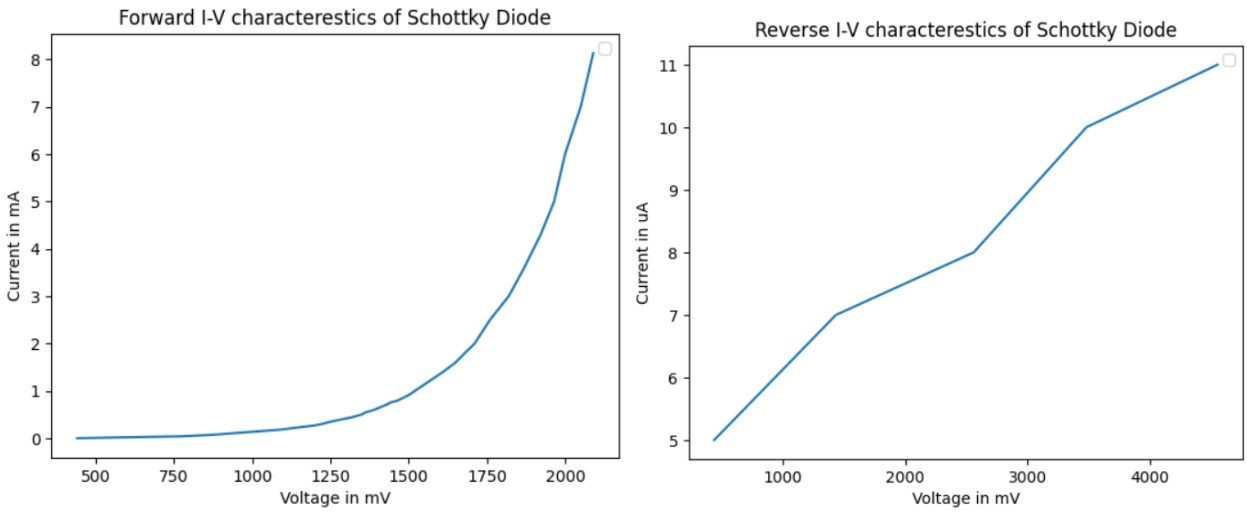
4. The V_{bi} for the Schottky diode is around 1200mV = 1.2V
5. Taking $V_A = 0$V, we get $1.2465\mu m$.
6. Taking $V_A = 0.5$V, we get $0.952\mu m$.

3 Part 2a

3.1 Circuit

The circuit used here is the same as the first one

3.2 Plots



4 Part 2b:

4.1 Circuit Design

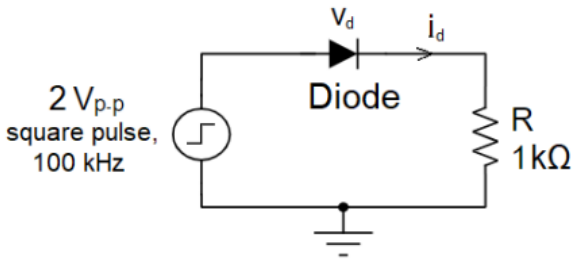


Figure 2: Circuit for RRT

4.2 Readings

Diode Type	Reverse Recovery Time (RRT) (ns)
PN	1640
Schottky	920

Table 1: Comparison of Reverse Recovery Time for PN and Schottky Diodes

4.3 Reasoning

- Schottky diodes have a much faster reverse recovery time compared to PN diodes because they do not rely on minority carrier injection. The current conduction in Schottky diodes is dominated by majority carriers (electrons in n-type material).
- Since there is no significant storage of minority carriers, there is very little to "clear out" when the diode switches from forward to reverse bias, leading to a shorter reverse recovery time (920 ns).
- So Schottky diodes are preferred in high-speed switching applications.