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Department of Biomedical Engineering

Course Name: 23BMB101-Electron Devices and Circuits

I Year : II Semester

Unit I –Semiconductor Diodes

Topic : Zener Diode



INTRODUCTION



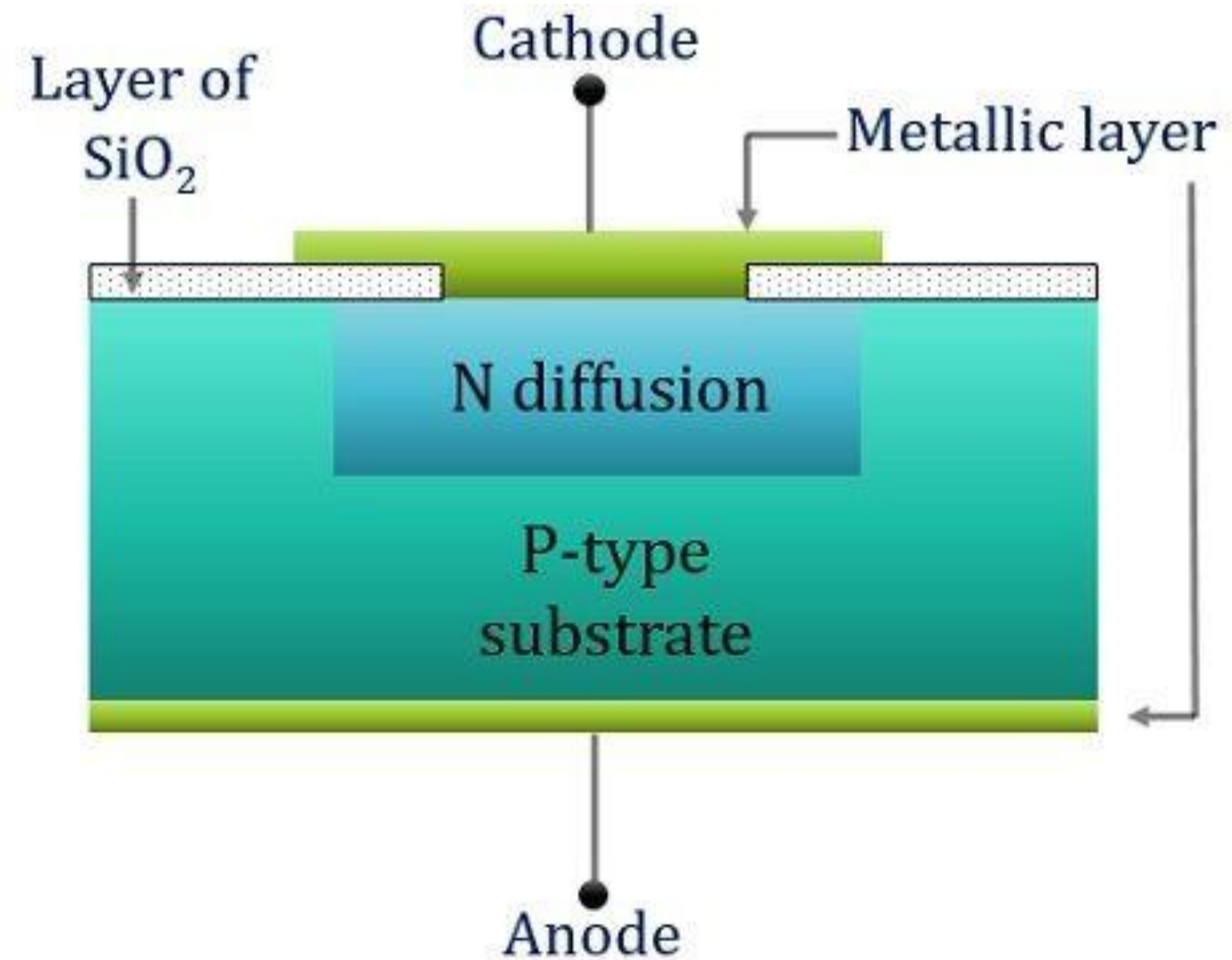
- A Zener Diode, also known as a breakdown diode, is a heavily doped semiconductor device that is designed to operate in the reverse direction.
- When the voltage across the terminals of a **Zener diode** is reversed and the potential reaches the Zener Voltage (knee voltage), the junction breaks down and the current flows in the reverse direction. This effect is known as the **Zener Effect**.



Zener Diode



Symbol of Zener Diode



Structure of Zener Diode



PN Junction

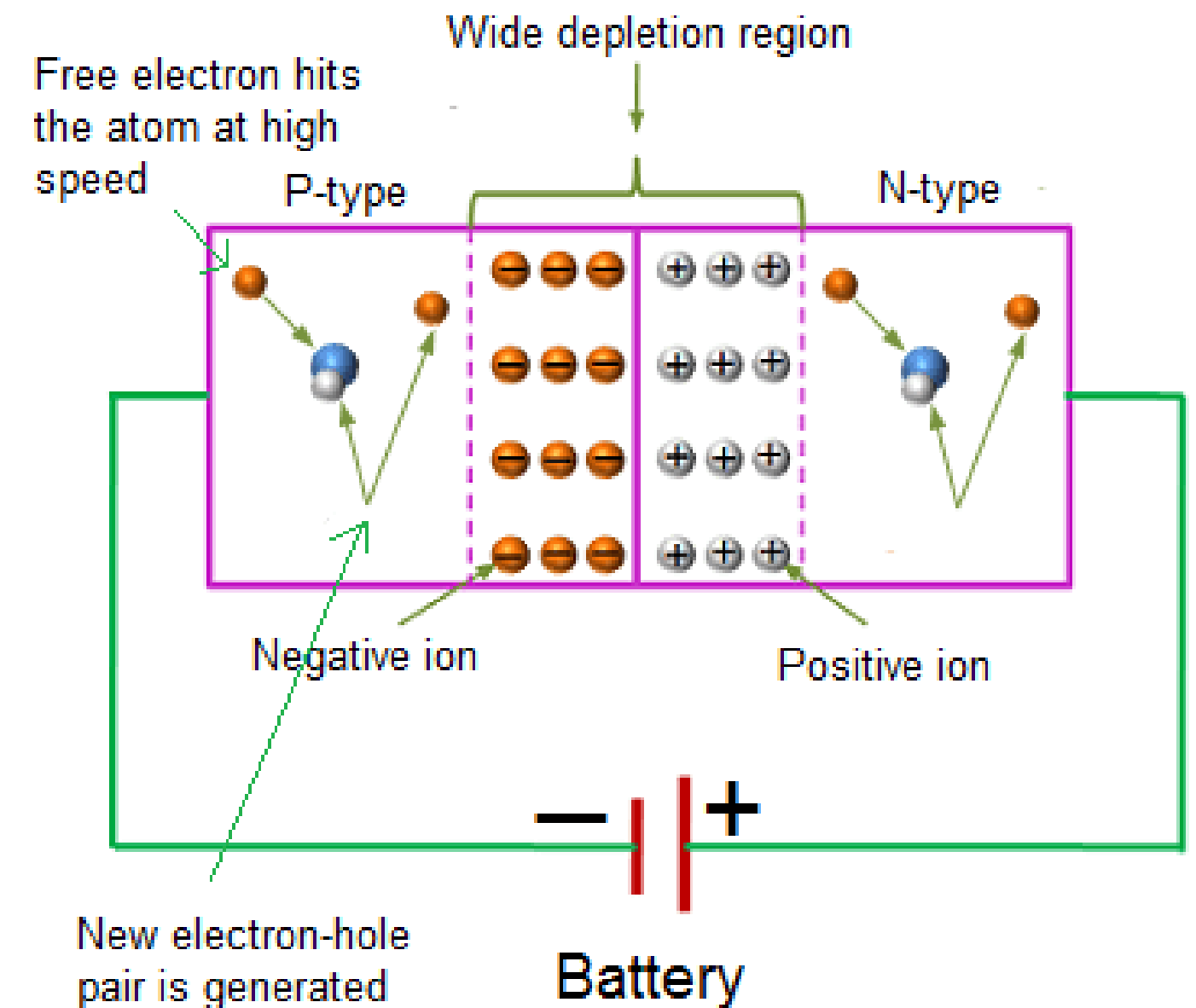


- Zener diode allows electric current in forward direction like a normal diode but also allows electric current in the reverse direction if the applied reverse voltage is greater than the Zener voltage.
- Zener diode is always connected in reverse direction because it is specifically designed to work in reverse direction.
- Zener diode is highly doped thus its depletion width is very thin. Due to this, more current flows through a zener diode as compared to a normal junction diode.
- A zener diode shows two breakdown approach, zener breakdown, and avalanche breakdown.



Avalanche breakdown

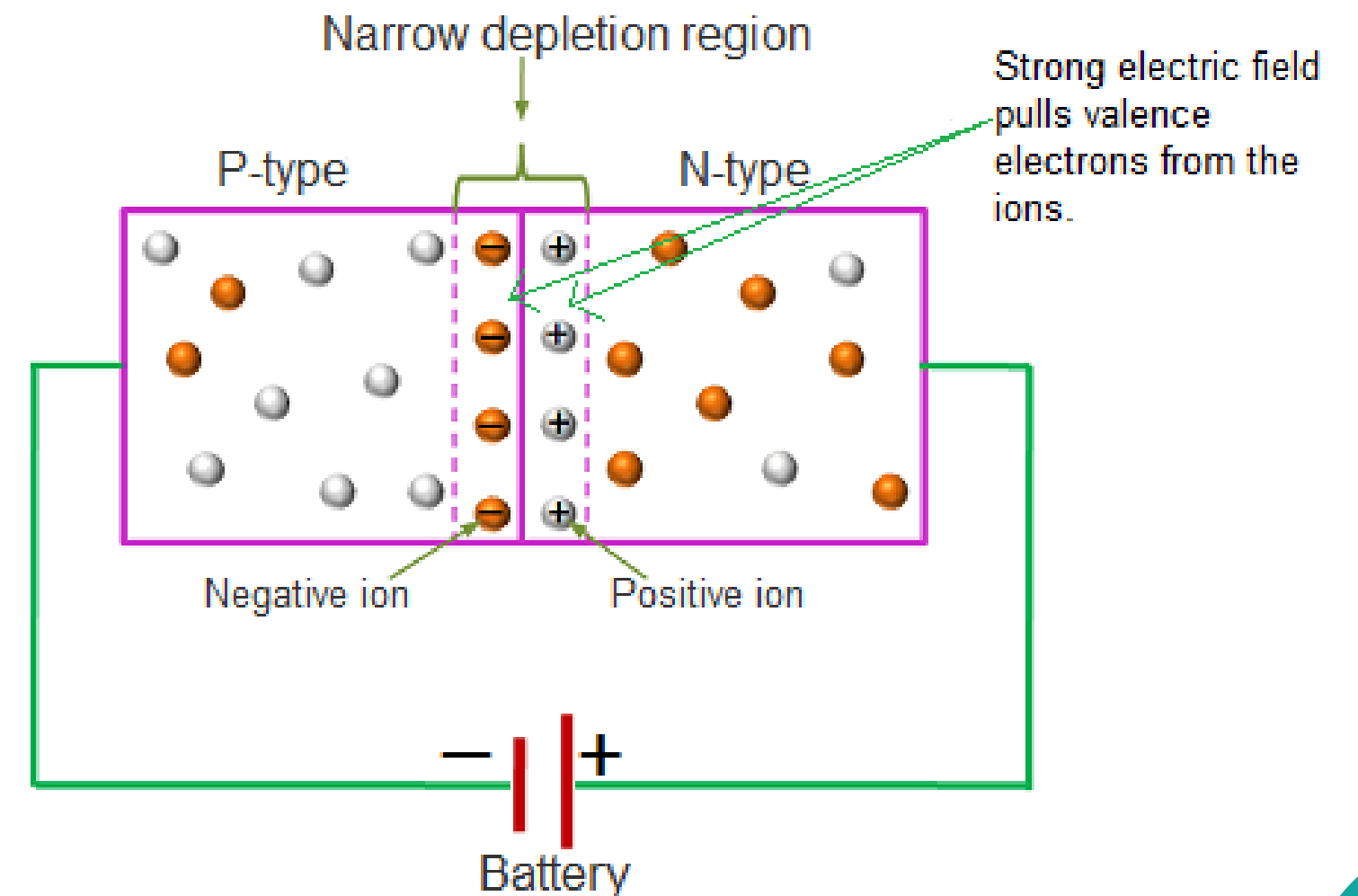
- When high reverse voltage is applied to the p-n junction diode, the free electrons (minority carriers) gains large amount of energy and accelerated to greater velocities.
- These electrons are again accelerated and collide with other atoms.
- As a result, electric current in the diode increases rapidly.
- Avalanche breakdown occurs in zener diodes with zener voltage (V_z) greater than 6V





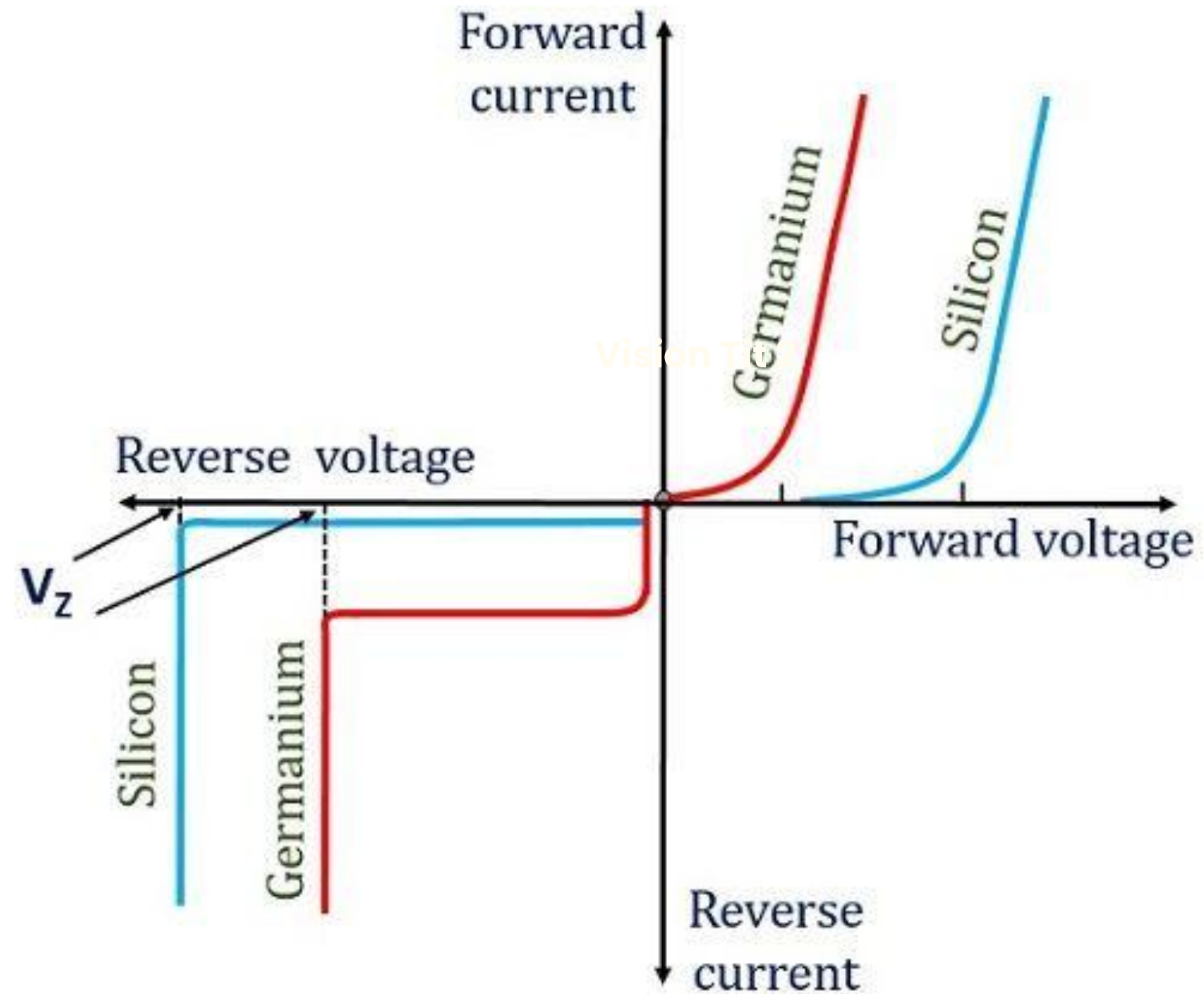
Zener breakdown

- The zener breakdown occurs in heavily doped p-n junction diodes because of their narrow depletion region.
- When reverse biased voltage applied to the diode is increased, the narrow depletion region generates strong electric field.
- When reverse biased voltage applied to the diode reaches close to zener voltage, the electric field in the depletion region is strong enough to pull electrons from their valence band.
- At zener breakdown region, a small increase in voltage will rapidly increases the electric current.





VI characteristics of Zener diode



V-I characteristics of Zener Diode