N-TYPE SEMICONDUCTORS AND THEIR PROPERTIES

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Abstract. *This Article Discusses The Physical Nature Of N-Type Semiconductors, The Mobility Of Charge Carriers, Their Electrical Conductivity Properties, And Their Applications In Modern Electronic Devices. It Also Analyzes The Methods For Creating N-Type Semiconductors And Their Technological Advantages.*

Introduction

Semiconductors Are Substances Whose Electrical Conductivity Is Intermediate Between That Of An Insulator And A Metal. In Their Energy Structure, There Is A Certain Energy Gap Between The Valence Band And The Conduction Band. There Are Two Main Types Of Semiconductors: N-Type And P-Type . Their Difference Is Determined By The Nature Of The Main Charge Carriers. In N-Type Semiconductors, The Main Charge Carriers Are Electrons.

Main Part

N-Type Semiconductors Are Made By Adding Donor Elements To A Natural Semiconductor Material (Such As Silicon — Si Or Germanium — Ge) . Donor Elements (Such As Phosphorus, Antimony, Or Arsenic) Have One More Electron In Their Atomic Structure Than Silicon. This Electron Moves Freely In The Crystal Lattice, Increasing The Electrical Conductivity Of The Material [1] .

This Process Is Called Doping And Plays A Key Role In Determining The Electron Concentration Of A Semiconductor. Due To The Low Energy Of The Donor Atoms, Their Electrons Easily Move Into The Conduction Band.

In An N-Type Semiconductor, The Fermi Level (Ef) Is Located Close To The Conduction Band. This Means That The Material Has A Large Number Of Electrons, So The Current Flows Mainly Due To Negatively Charged Carriers (Figure 1). The Energy Bands Can Be Represented As Follows [2] :

Ec — Conductivity Zone
Ef — Fermi Level (Close To Donors)
Ev — Valence Zone

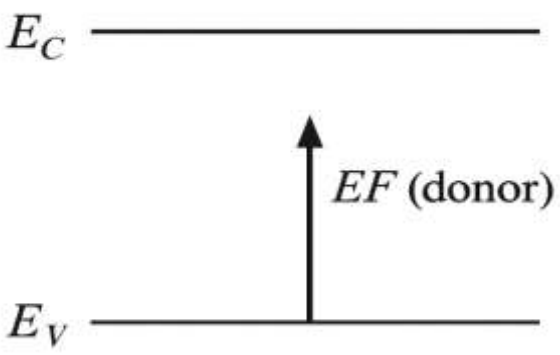

Figure 1. Fermi Diagram

This Structure Provides Information About The Direction Of Current Conduction In The Material And The Nature Of The Charge Carriers.

In N-Type Semiconductors, Conductivity Is Determined By The Movement Of Electrons. As The Temperature Increases, More Electrons From The Donor Atoms Gain Energy And Move Into The Conduction Band. This Process Makes It Easier For Current To Flow.

The Dependence Of Electrical Conductivity On Temperature Is Exponential And Can Be Expressed By The Following Equation:

$$\Sigma = Ne\mu$$

Here:

N Is The Number Of Free Electrons,

E Is Electron Charge,

M Is The Mobility Of Electrons.

N-Type Semiconductors Are Actively Used In Various Electronic Devices:

Diodes (To Form A Pn Junction),

Transistors (Npn Structure),

Sensors And Photocells ,

Microcircuits And Integrated Systems .

Also Play An Important Role In Modern Nanotechnology And Quantum Electronic Devices .

The Main Advantages Of N-Type Semiconductors Are High Mobility And Low Resistance. However, They Are Sensitive To External Factors (Temperature, Radiation, Humidity) And In Some Cases Require Additional Protection Measures To Ensure Stability [3].

Conclusion

N-Type Semiconductors Are An Important Element Of Modern Electronic Systems. They Are Based On The Movement Of Current Carriers Through Electrons, Which Allows

You To Create High-Speed And Low-Power Devices. Therefore, The Study Of N-Type Semiconductors And The Development Of New Materials Based On Them Is One Of The Urgent Tasks Of Modern Physics.

Used Literature

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