

MATERIALS USED IN ELECTRONICS

INSULATORS, CONDUCTORS, AND SEMICONDUCTORS



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Insulators: An insulator is a material that does not conduct electrical current under normal conditions. Most good insulators are compounds rather than single-element materials and very high resistivity's. have Valence electrons are tightly bound to the atoms; therefore, there are very few free electrons in an insulator. Examples of insulators are rubber, plastics, glass, mica, and quartz.

Conductors: A conductor is a material that easily conducts جَـامعة المَـنارة electrical current. Most metals are conductors. The best good conductors are single-element materials, such as copper (Cu), silver (Ag), gold (Au), and aluminum (AI), which are characterized by atoms with only one valence electron very loosely bound to the atom. These loosely bound valence electrons become free electrons. in a conductive material the free electrons are valence electrons.

Semiconductors:



- A semiconductor in its pure (intrinsic) state is neither a good conductor nor a good insulator.
- Single-element semiconductors are antimony (Sb), arsenic (As), astatine (At), boron (B), polonium (Po), tellurium (Te), silicon (Si), and germanium (Ge).
- The single-element semiconductors are characterized by atoms with four valence electrons. Silicon is the most commonly used semiconductor.
- Compound semiconductors such as gallium arsenide, indium phosphide, gallium nitride, silicon carbide, and silicon germanium are also commonly used.





BOHR DIAGRAMS



Conductor Atom





DIAGRAMS OF THE SILICON AND GERMANIUM ATOMS.





The center silicon atom shares an electron with each of the four surrounding silicon atoms, creating a covalent bond with each.





Creation of electron-hole pairs in a silicon crystal. Electrons in the conduction band are free electrons.



N-TYPE SEMICONDUCTOR

Sb

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Free (conduction) electron from Sb atom

> **Pentavalent** impurity atom in a silicon crystal structure. An antimony (Sb) impurity atom is shown in the center. The extra electron from the RA UN Sb atom becomes a free electron.





NEXT LECTURE

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