

CATEGORY: 5.8	MATERIALS	ELECTRONIC
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INTRODUCTION

The field of electronics is described as manipulating electrical currents and voltages, using passive and active components that are connected together to create a circuit. Passive devices are generally described as having only an input and an output, whereas active components can have multiple connections to provide some function acting on the electricity passing through it. Measurements used in electrical and electronic applications include current (amp), voltage (volt), charge (coulomb), resistance (ohm), magnetic inductance (henry).

SEMICONDUCTORS

Semiconductors are described as having electrical conductance properties between insulating materials and highly conductive metals. Changing the temperature of semiconductors changes their ability to conduct or resist electricity. The higher the temperature the better its ability to conduct electricity and the lower the temperature the better its ability to insulate against the flow of electricity.

Silicon

Silicon is the most widely used semiconductor material. N-type (negative) and P-type (positive) semiconductors are doped with phosphorus and aluminium respectively. This alters their properties to produce free electrons in the N-type and an electron deficiency in the P-type materials.

Germanium

Germanium has a higher electron travelling speed than silicon, but has proved difficult to work with. It is used in the manufacture of transistors and integrated circuits. Germanium is alloyed with silicon to provide a variety of materials with a wider range of application possibilities, especially components with higher operating speed requirements.

Gallium Arsenide

Gallium Arsenide is used to convert electricity into coherent light. This property is used in Light Emitting Diodes (LED's). Other properties include a higher electron speed than silicon, which promotes its use on silicon microchips. Gallium Arsenide is more expensive than germanium and silicon.

Ceramic

Ceramic semiconductors are used for temperature measurement and control. The device is called a thermistor (thermally sensitive resistor). The resistance of the ceramic material changes with the temperature.

Ferroelectric ceramics, primarily Barium Titanate, are used in piezoelectric devices, which convert pressure signals to electrical signals and vice versa.

CONDUCTIVE ADHESIVES

Electrical and Thermal conductive adhesives are used for bonding electronic components together, resulting in a joint that is capable of transmitting electricity. Different strengths of adhesives are available to suit a wide variety of applications.

The electrical conductive adhesives are epoxy resins that have been loaded with silver to provide either isotropic or anisotropic conducting abilities.

For thermal conducting capability the adhesive is supplied as a single component adhesive that requires application of heat or a catalyst to activate. Thermal conducting adhesives are commonly used to adhere heat sinks to electronic components to dissipate heat.

(ELECTRONIC) Internet Resources

[Centre for Electronic Materials](#) (CEM) is located in the Department of Electrical Engineering and Electronics at UMIST and conducts research into electronic materials.

[Electronic and Photonic Molecular Materials](#) based at Sheffield University carries out research into organic and polymeric materials and their electrical and optical characteristics.

[Department of Electronics](#) based at the University of York, conducts industrial, research and educational activities in a variety of electronic areas.