Electrical Conductivity

The ability to conduct electricity varies enormously between different types of solids.

Resistivity ρ is defined by:
$$J = \frac{I}{A} = \frac{1}{\rho}E \qquad \rho = \frac{1}{\sigma} = \frac{m}{ne^2\tau}$$

where J = current density and E = applied electric field.

Resistivity depends on the scattering time for electrons.

Resistivity depends on the number of free electrons.

Example properties at room temperature:

Material	Resistivity (Ω-m)	Carrier Density (cm^{-3})	Type
Cu	2×10^{-8}	10^{23}	conductor
Si	3×10^3	10^{10}	semiconductor
Diamond	2×10^{16}	small	insulator