

# Resistance and Resistivity



- **Resistor:** device (material object with two terminals)
- **Resistance:** attribute of device
- **Resistivity:** attribute of conducting material

A voltage  $V$  provided by some source is applied to the terminals of a resistor and a current  $I$  is observed flowing through the resistor.

- Resistance:  $R = \frac{V}{I}$  [1Ω=1V/A] (1 Ohm)

The current density  $\vec{J}$  in a resistor depends on the local electric field  $\vec{E}$  and on the resistivity  $\rho$  of the resistor material.

- Resistivity:  $\rho = \frac{E}{J}$   $\left[ \frac{1\text{V/m}}{1\text{A/m}^2} = 1\Omega\text{m} \right]$
- Conductivity:  $\sigma = \frac{1}{\rho}$  [1(Ωm)<sup>-1</sup>]
- Vector relations:  $\vec{E} = \rho\vec{J}$ ,  $\vec{J} = \sigma\vec{E}$