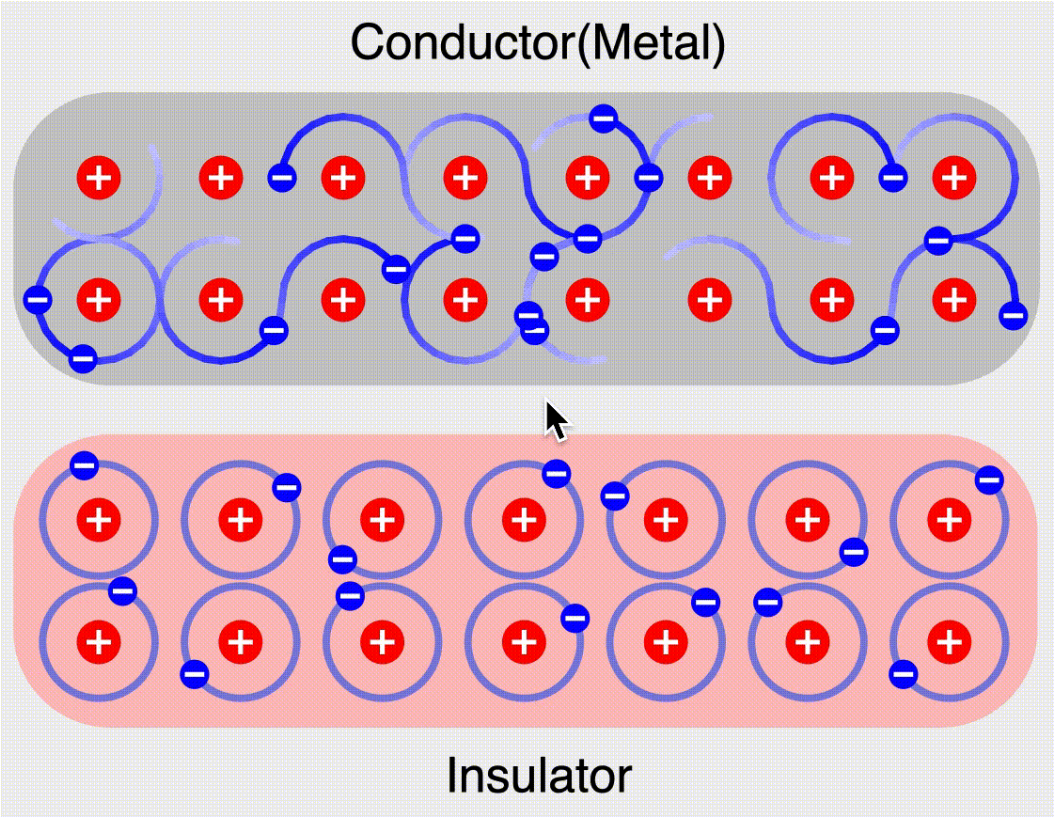
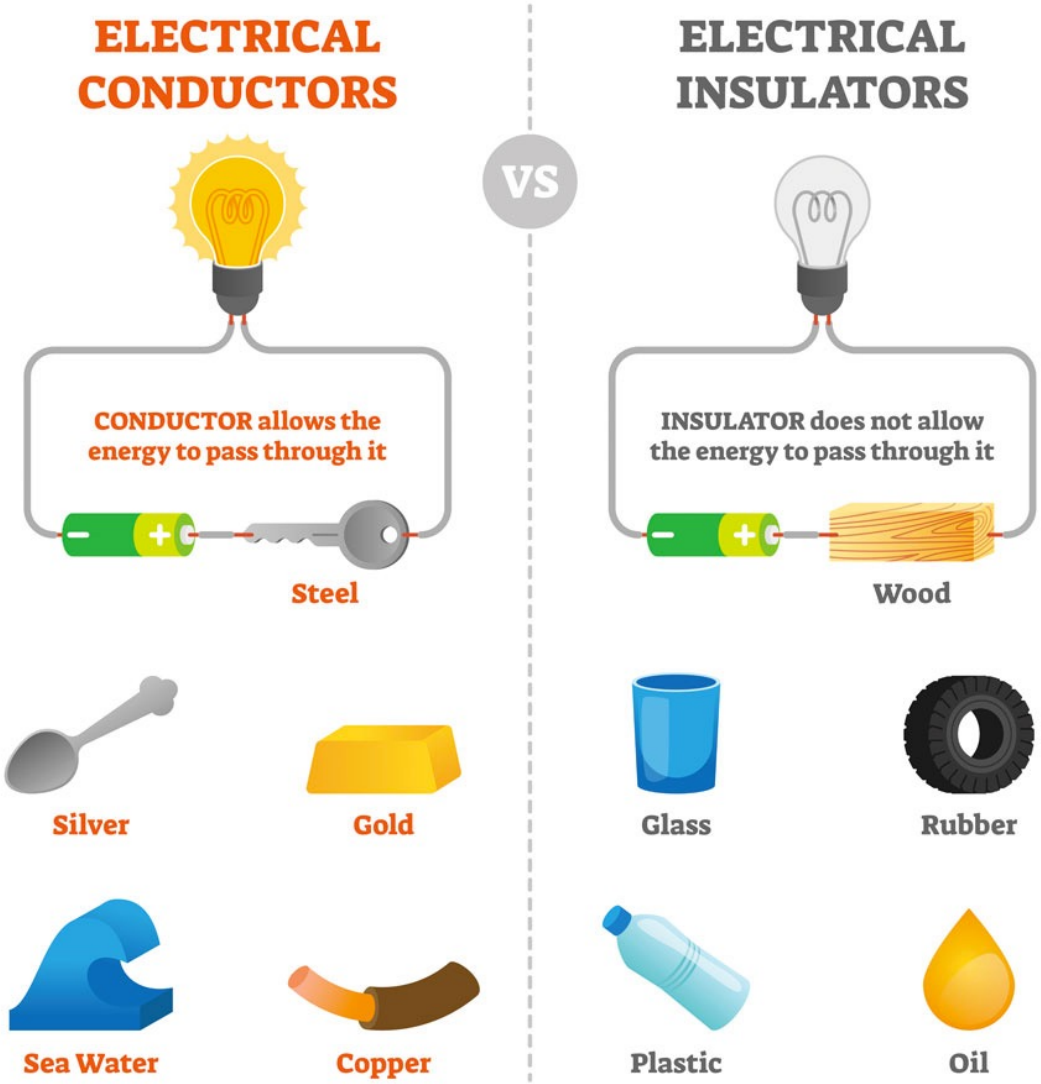
Measurement of the temperature coefficient of a thermistor

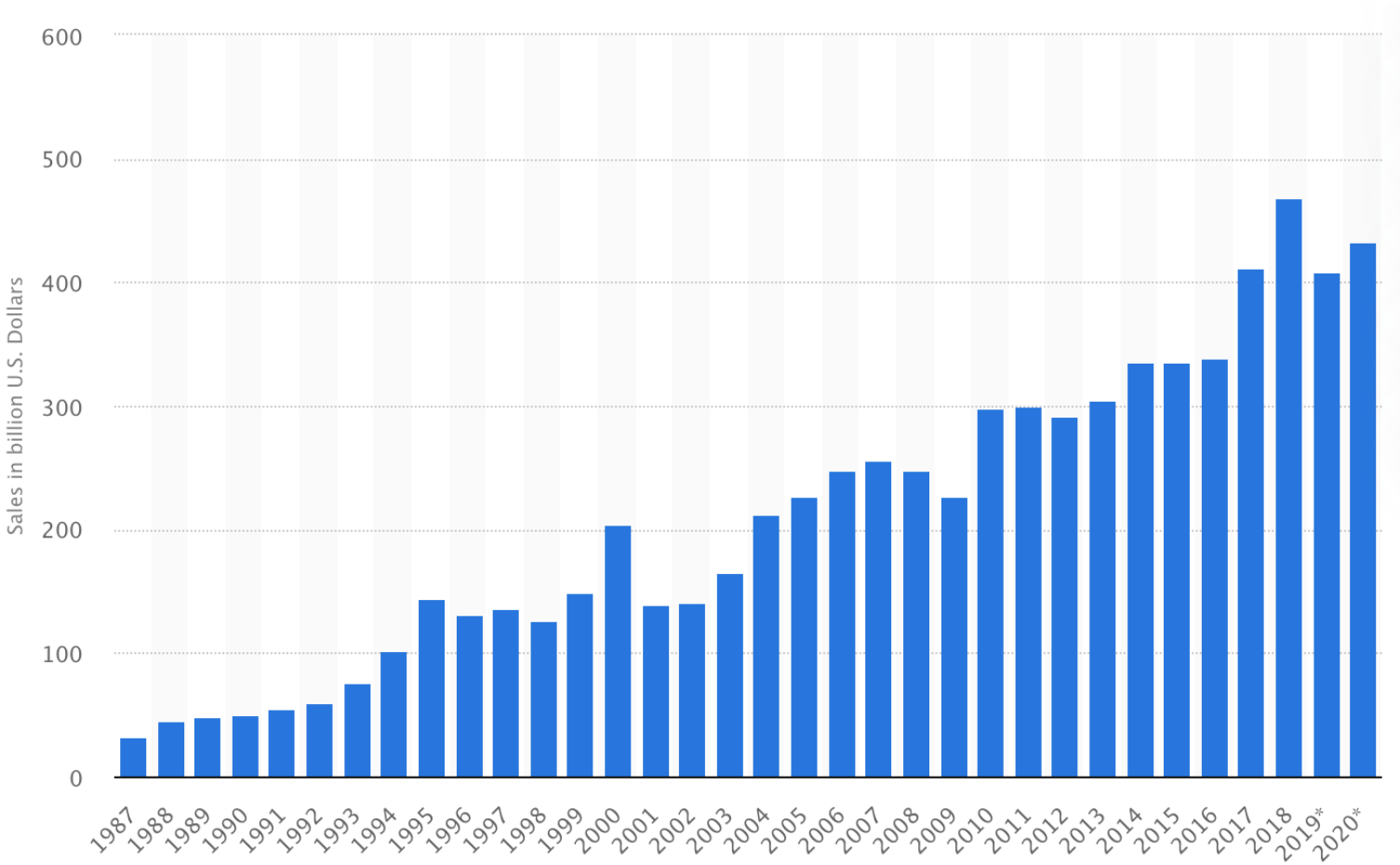
Mingquan He| College of physics

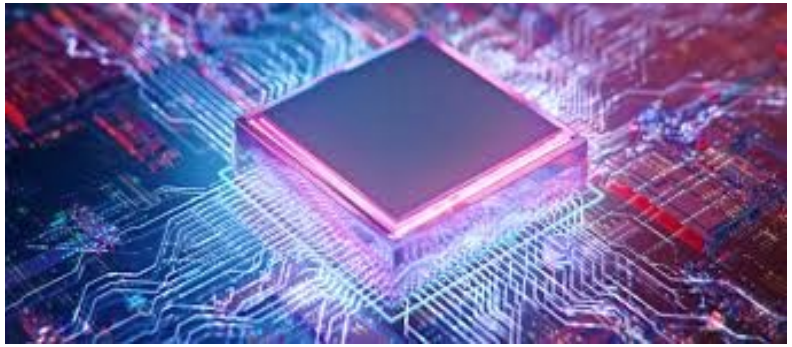
Types of materials





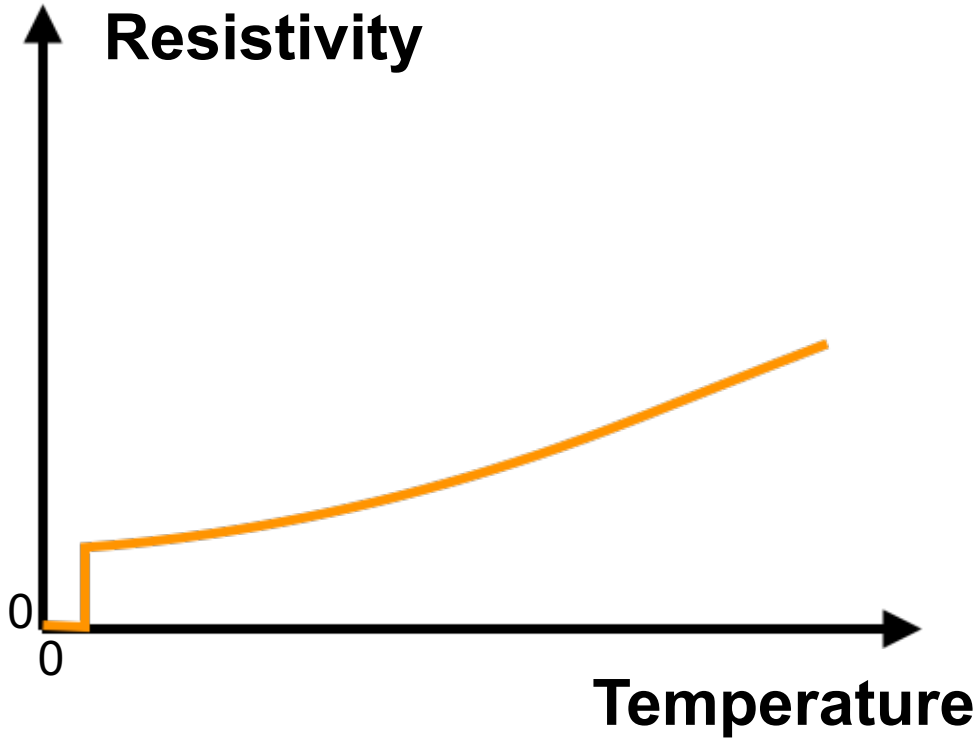
Types of materials





Semiconductors

Types of materials

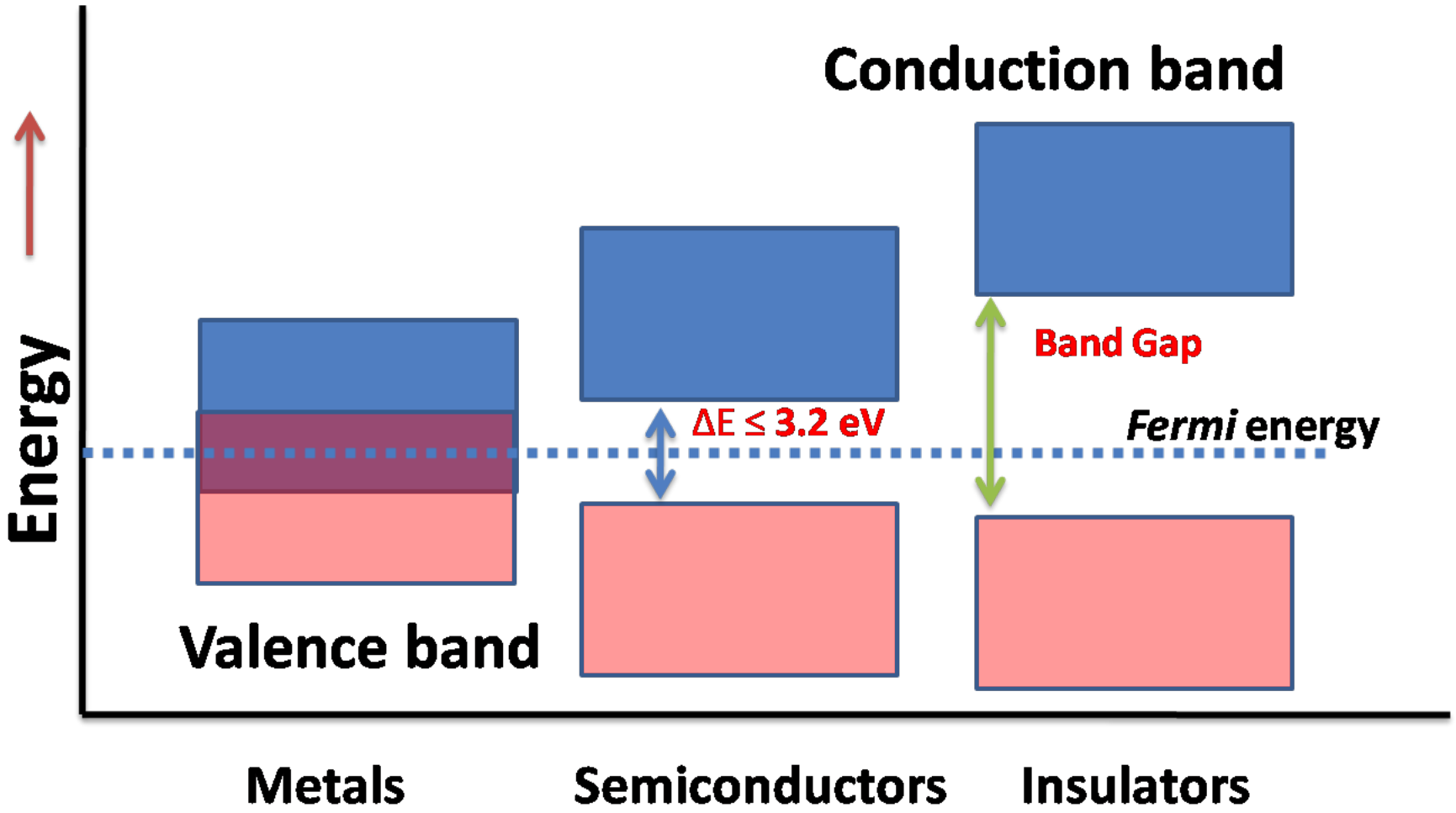


Zero Resistivity

Magnetic Levitation
Speed Record:581 km/h

Superconductors

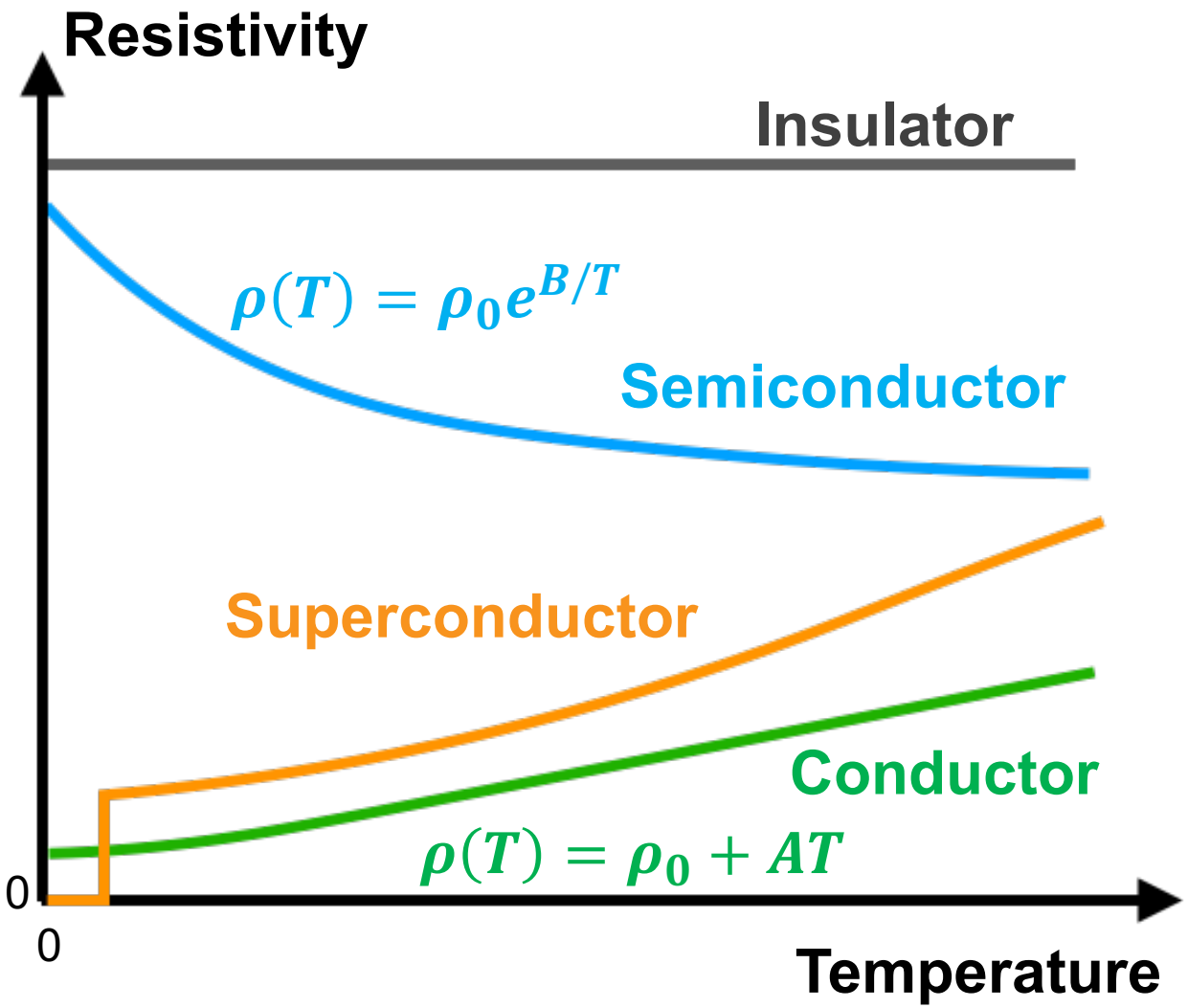
Types of materials



Quantum Mechanics

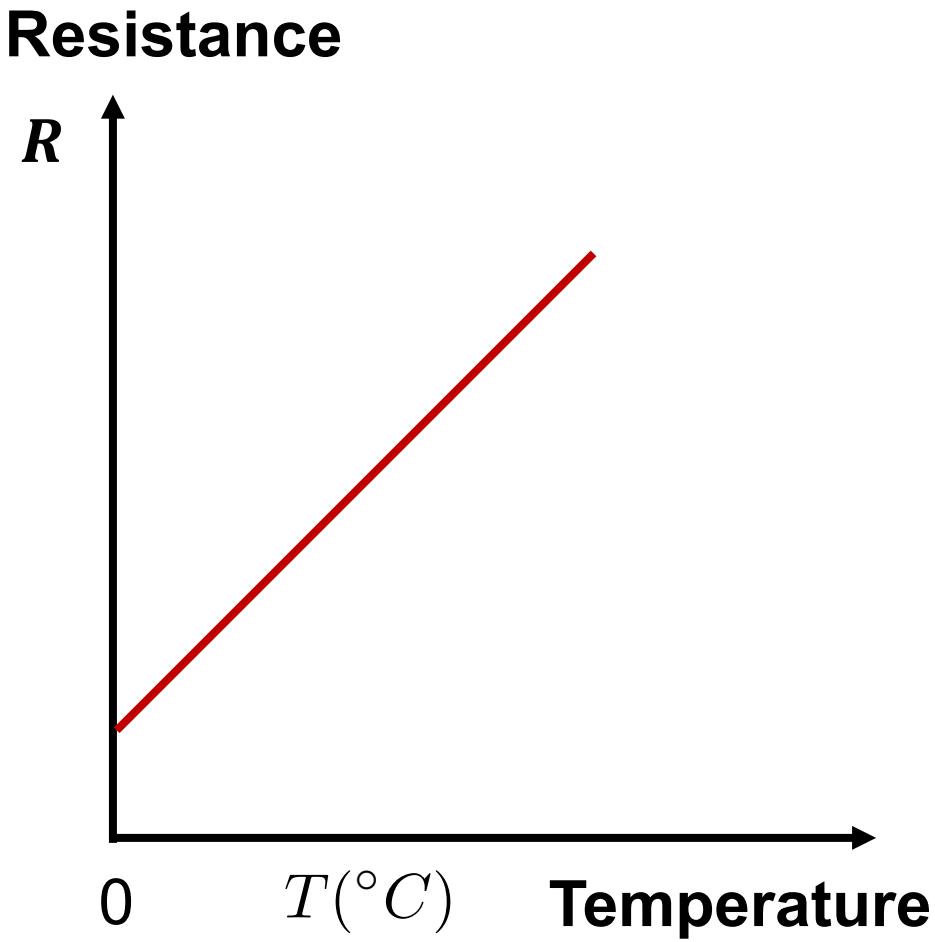
Band Theory of solids

Temperature Dependencies



Material	Resistivity, ρ (Ω·m)
Superconductors	0
Metals	10^{-8}
Semiconductors	Variable
Electrolytes	Variable
Insulators	10^{16}
Superinsulators	∞

Conductors



$$R(T) = R_0(1 + \alpha T)$$

R_0: Resistance at 0 ℃

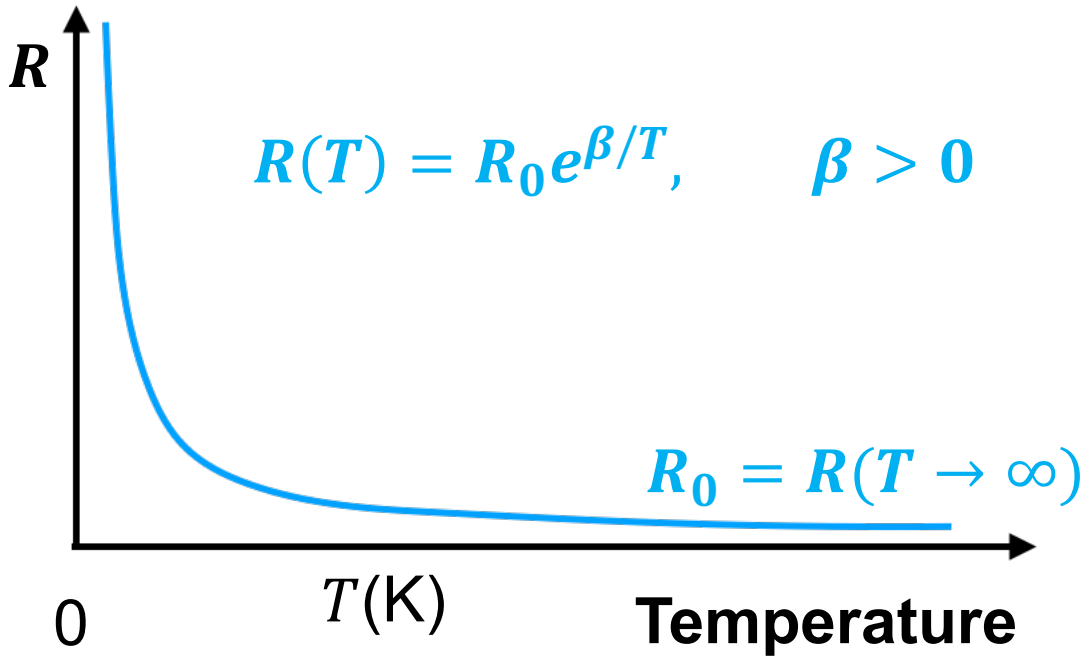
α: Temperature coefficient.

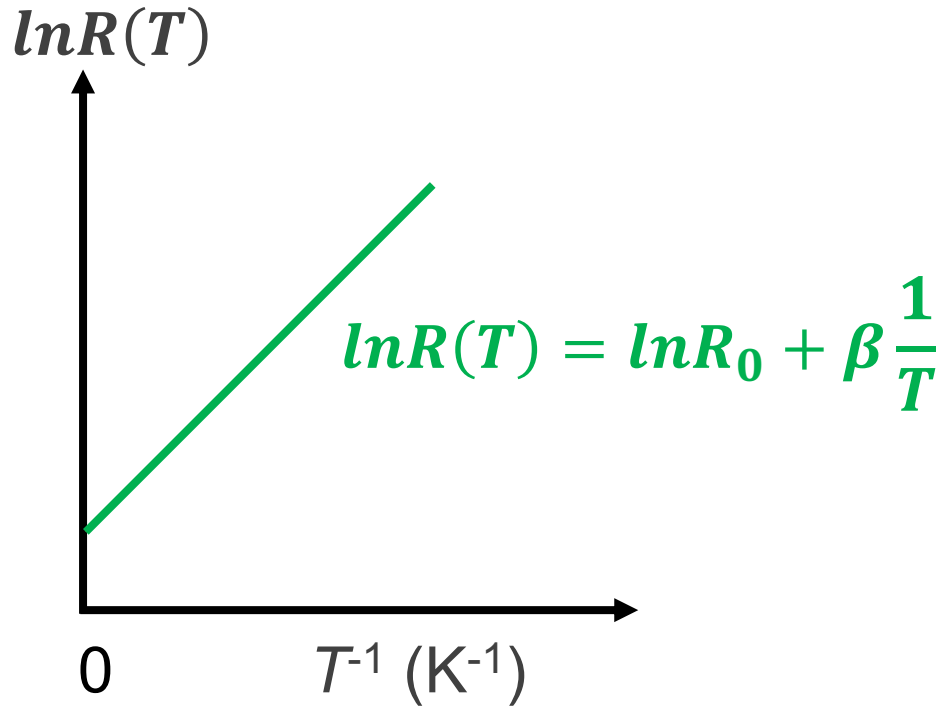
For copper Cu, $\alpha = 4.28 \times 10^{-3}$ ℃$^{-1}$

The resistance of a conductor scales linearly with temperature.

Semiconductors

Resistance





Negative Temperature Coefficient

$$\alpha(T) = \frac{1}{R(T)} \frac{dR(T)}{dT} = -\beta T^{-2} < 0$$

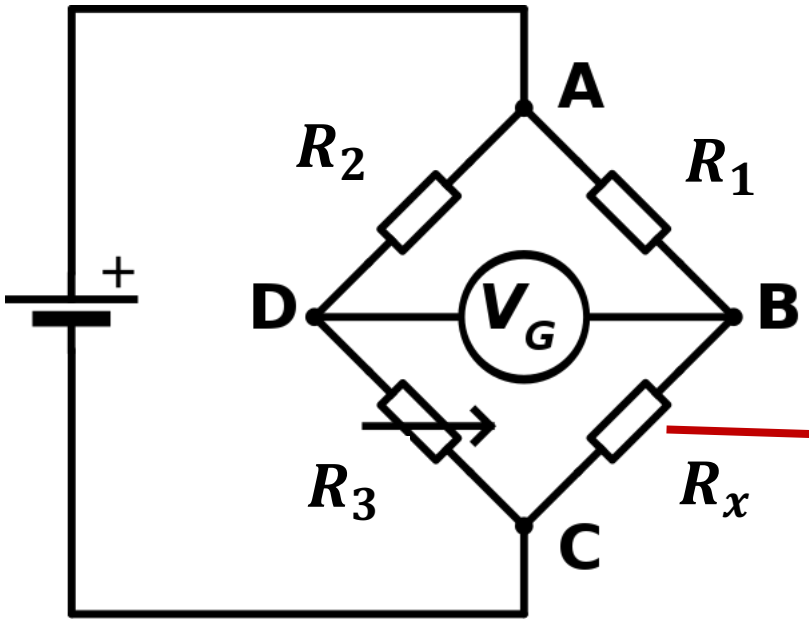
Kelvin temperature:

T(K)= T(℃)+273.15

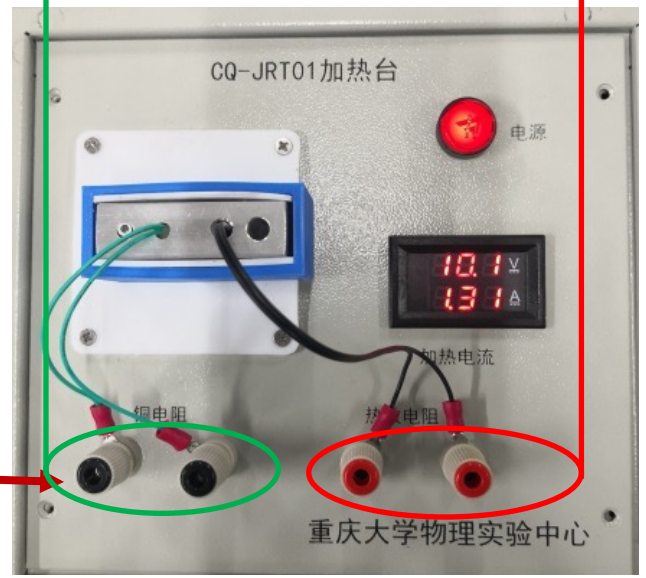
Widely used as Thermometer.

R(T) measurement

Wheatstone bridge



Copper **Thermistor**



Temperature Controller

Arm ratio: $\frac{R_1}{R_2}$

Shutter

R_3

R_x

At balance state:

$$V_G = 0 \qquad \frac{R_1}{R_x} = \frac{R_2}{R_3}$$

$$\boldsymbol{R_x = R_3 \frac{R_1}{R_2}}$$

Experiments

Temperature Controller

Current temperature reading

3. Press SET to control the temperature.

4. Wait until T is stabilized before performing measurements.

1. Press ◅ to enter the set point editing panel.

2. Press Δ or ∇ to change the temperature set point.

Experiments

Wheatstone bridge

1.Use internal connection

2. Set the power supply to 3 V.

4. Choose an arm ratio.

5. Choose R_3.

3. Connect R_x into the bridge.

6. Press G to check I_G.

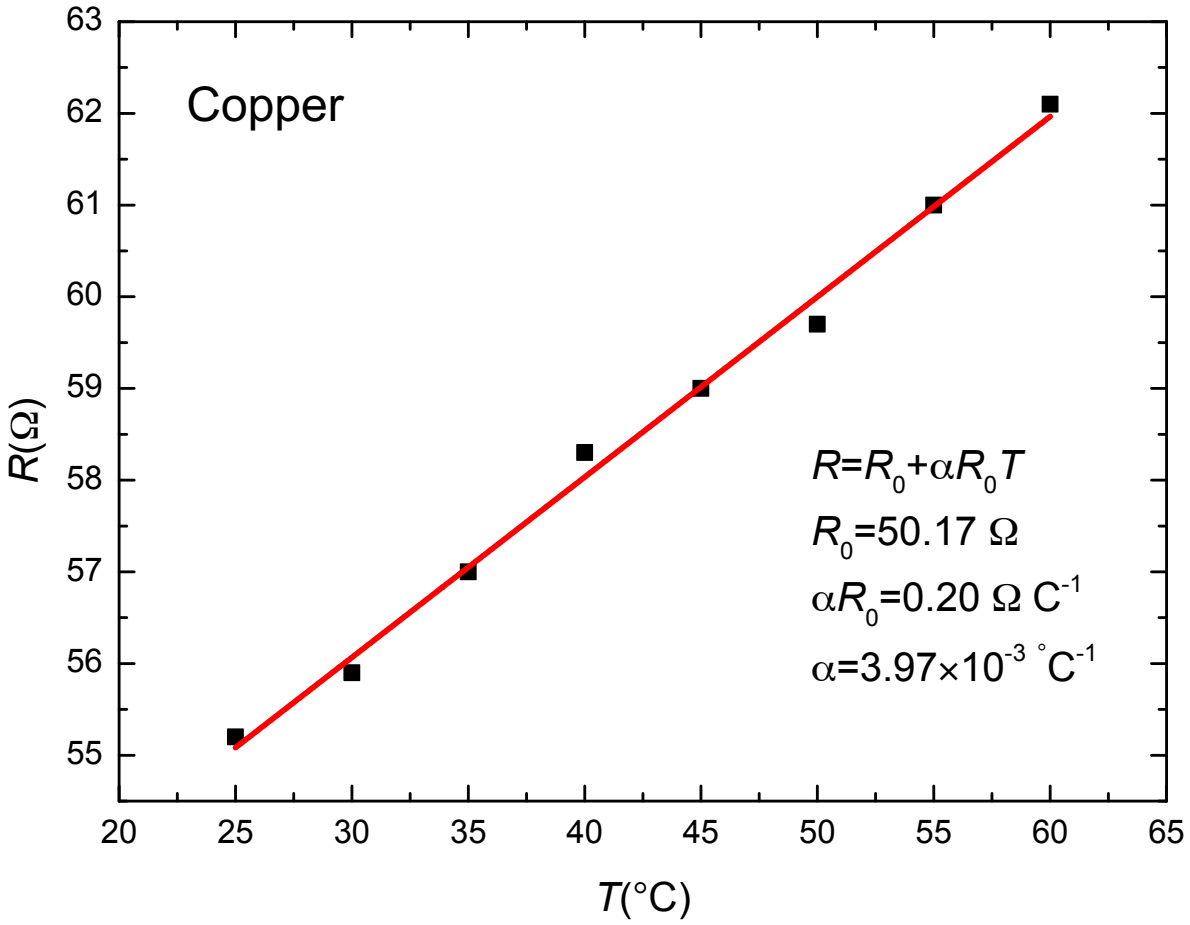
7. Adjust arm ratio and R_3 to reach the balance state.

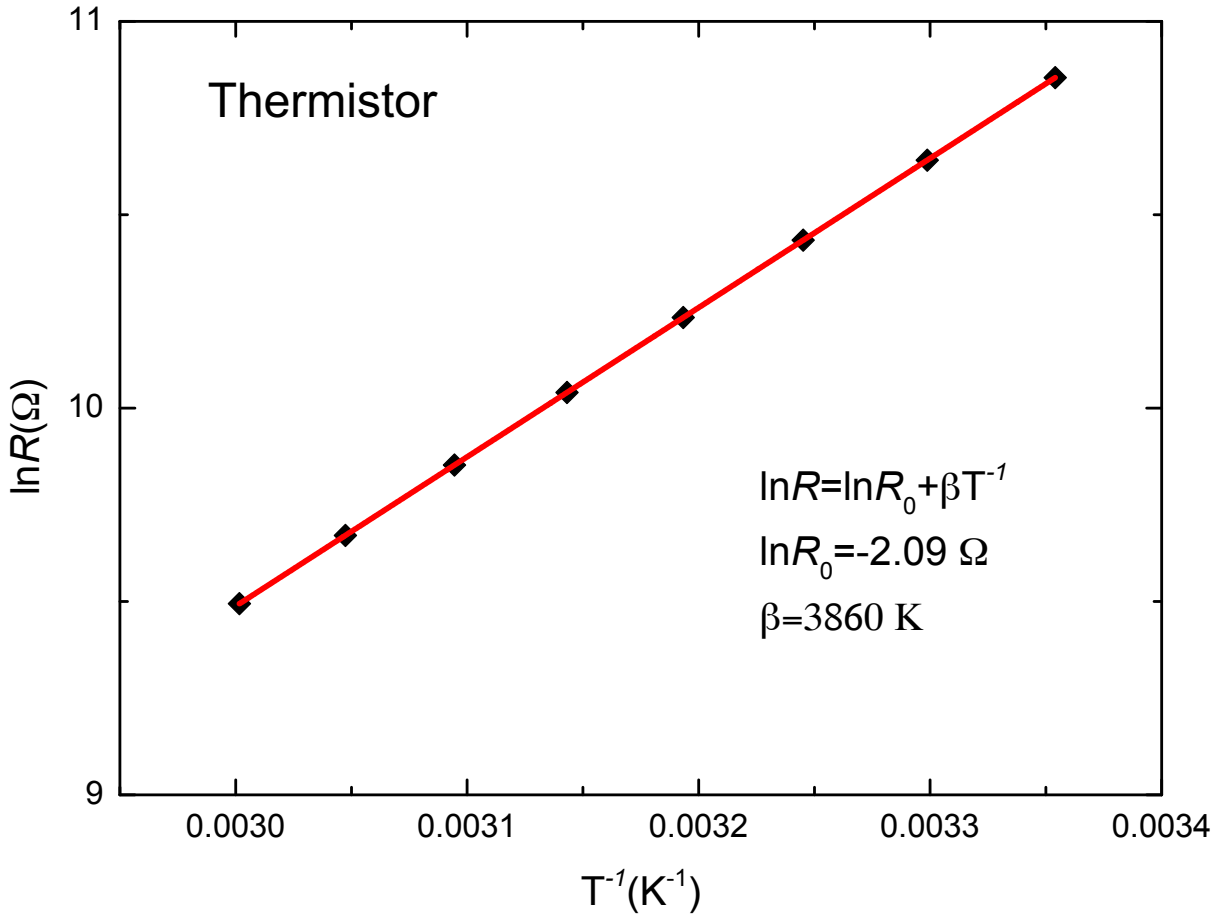
Data Recording

Appendix Table I: Experimental Raw Data

Copper	T(°C)			Resistance(Ω)
Thermistor	T(°C)	T(K)	$T^{-1}(K^{-1})$	Resistance(Ω)

Analysis





Reference value α_0=4.28×10^{-3} °C^{-1}

Relative Error: 7.2%

T(K)= T(℃)+273.15

Reference value β=3950 K

Relative Error: 2.7%

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THANK YOU！