Determining Resistivity with a Four-Terminal Measurement

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PHY—0000

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1 Aim

Determine the resistivity of a uniform wire from measurements of potential difference and current, while separating contact resistance from the sample.

2 Theory

For a wire of length L and cross-sectional area A,

$$R = \rho \frac{L}{A}, \qquad \rho = \frac{V}{I}\frac{A}{L}.$$

The four-terminal arrangement measures V across the inner contacts, so the lead and contact drops contribute little to the measured potential.

3 Apparatus and method

List the wire, current source, voltmeter, micrometer and temperature probe. Measure diameter at five positions, then sweep current in both directions. Stop if the sample temperature changes appreciably.

4 Data

Table 1: Current–voltage readings for a 0.500 m wire.

I (mA)	V (mV)	R (Ω)	Temperature (°C)
10	18.2	1.82	21.0
20	36.5	1.83	21.1
30	54.7	1.82	21.4
40	73.2	1.83	21.9

5 Analysis and uncertainty

Fit $V = mI + b$ and report m, b, residuals and the uncertainty in the slope. Propagate diameter, length and slope uncertainties to ρ; state whether temperature drift could explain any curvature.

6 Conclusion

- Measured resistance: _____
- Resistivity and uncertainty: _____
- Comparison with reference value: _____