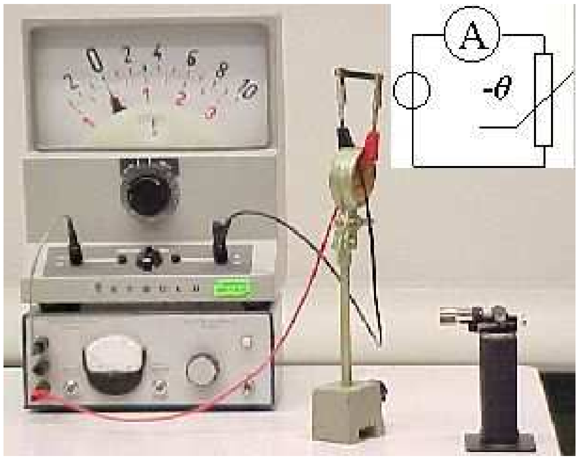
Negative temperature coefficient

Aim: To show how the resistance of a semiconductor (P-Ge) depends on temperature.

Subjects: 5D20 (Resistivity and Temperature)

Diagram:



Equipment:

- Bar of P-Ge
- Power supply
- Current meter with large display
- Gasflame

Negative temperature coefficient

Presentation: Set the Ammeter at a 1A-scale. The voltage of the power supply is raised until a current of about 0.05 A flows in the circuit. The bar of P-Ge is heated by the gasflame and soon the current rises to a much higher value. After a short time of heating the gasflame can be removed and the current continues to rise, faster and faster, only limited by the powersupply.

Explanation: The resistance of a semiconductor drops with temperature because at a higher temperature there are more free charge-carriers in it.

The current flowing in the material heats it up: $P_{el} = \frac{V^2}{R}$ The heat leaving the piece of material is proportional to ΔT: $P_{out} \propto \Delta T$ (Newton cooling). When $P_{out}=P_{el.}$ there will be thermal equilibrium and the temperature is constant. Reaching such an equilibrium takes some time.

In this demonstration R lowers due to a rise in temperature and so $P_{el.}$ rises due to a rise in temperature. When this rise is faster than the rise of P_{out} an ever faster rising of ΔT (like an avalanche) will result.