Experiment 6:
Light Bulb Fabrication

Purpose:

To fabricate a light bulb that can operate in air.

Materials Needed:

1. Variac transformer or dc power supply or batteries
2. Copper leads
3. 0.010 inch diameter Kanthal AF wire
4. 0.003 inch diameter Kanthal AF wire

Procedure:

The teacher or ***closely supervised*** students will build a simple light bulb using materials contained in this kit. ***This experiment is potentially dangerous so appropriate precautions must be taken.***

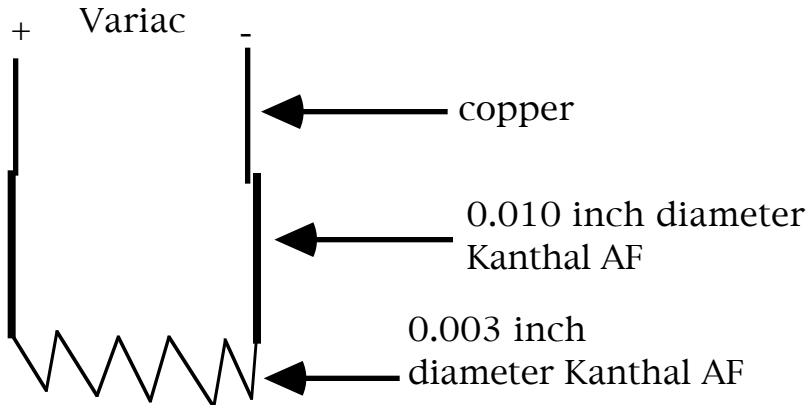
1. First, you will need a Variac transformer (preferred) or a dc power supply or batteries.

2. Connect the copper leads (use standard hook up wire or strip a power cord) from the Variac to the 0.010 inch diameter Kanthal AF leads by twisting the ends together.

3. Connect the 0.010 inch diameter Kanthal AF wires (like the lead wires in the light bulb) to the 0.003 inch diameter Kanthal AF wire (like the tungsten filament in the light bulb) by twisting the ends together.

4. By increasing the Variac voltage, the current to the 0.003 inch diameter Kanthal AF filament can be increased to resistively heat the filament and cause it to glow. For a filament about 20 cm long, a voltage of about 40 V is required. This can be done in air because the Kanthal AF wire is oxidation resistant.

Caution: This experiment should be done by the teacher or under close supervision. During this experiment these exposed wires are at potentially dangerous voltages and currents.



The electrical resistivity of the Kanthal AF wire is 1.4 x 10^{-4} ohm-cm at essentially all temperatures. This is quite different than the behavior of pure metals such as copper or tungsten, where the electrical resistivity increases significantly as the temperature increases. Have your students determine the electrical resistance of the Kanthal AF wire filament by calculation (using equation 4) and by measurement with the ohmmeter.

Application note: This experiment can be used to simulate the principle of a **hot wire anemometer**, a device for measuring the speed of a gas. In an anemometer, a very thin wire, usually made out of platinum, a nonreactive high melting point material, is exposed to a stream of gas and is heated well above the temperature of the gas by the passage of an electric current. The flowing gas cools the wire at a rate proportional to the speed of the gas flow, thus lowering the temperature of the wire. As noted earlier in this module, the resistance of the wire is a function of its temperature, decreasing as the wire temperature decreases (which is also the principle of a platinum resistance thermometer). The anemometer can be operated at a fixed current, with the voltage drop along the length of the wire being measured to determine how the electrical resistance changes. Hot wire anemometers can measure gas speeds ranging from 0.15 m/s to supersonic speeds and are capable of detecting rapidly varying speed changes.

To simulate the hot wire anemometer, just place a multi-speed fan near the Kanthal filament when it is on. First note the filament color (or if the appropriate equipment is available, measure the resistance of the filament) with the fan off. Now, turn the fan on and note the color (or measure the resistance) of the filament. As it cools, it changes color. Examine the color when the fan is on the higher settings. Note that the color of the wire (or the resistance of the filament) is a measure of the speed of the air flow.