

#### **4. Experimental Objectives**

- 1) Understand the mechanism of the transition between ferromagnetism and paramagnetism of ferrite materials.
- 2) Determine Curie temperature of ferrite materials using AC electrical bridge method.

#### **5. Precautions**

- 1) Check the wiring is correct before turning on the power. After experiment, turn off the power before removing the wiring;
- 2) Turn on power and warm up for 10 minutes before experiment;
- 3) Do not short circuit the two ends of the AC power output directly to avoid damage to the power supply;
- 4) When the heating rod is heated, the temperature is high. Do not touch it with your hands during the experiment to avoid burns;
- 5) Spread heat-conductive grease onto ferrite sample before placing it to the heating rod to prevent unevenly heating (heat-conductive grease prepared by user);
- 6) Do not adjust the amplitude of the signal generator or change the location of inductance coils during data acquisition process.

#### **6. Experimental Procedures**

- 1) Wire the AC electrical bridge according to the circuit diagram printed on the panel.
- 2) Turn on the power of the apparatus. Move the two inductance coils to the left and right ends of the heating rod respectively. Set proper amplitude for the signal source, adjust the two potentiometers to balance the AC electrical bridge (e.g. voltmeter reading  $<0.020$  V).
- 3) Shift the inductance coil on the right side of the heating rod to expose the sample cell on the copper rod, place all the three pieces of samples of the same kind into the cell and apply thermal grease evenly, shift the inductance coil back to previous position

(right end of the rod), leave the ferrite sample in the center of the inductance coil, at this moment, the bridge is out of balance.

- 4) Set the temperature to an expected value using Up/Down/Set/Reset buttons. When the temperature of the sample rod is stable within 1 °C of the set temperature, record the effective value of voltage  $V$  and the temperature  $T$  at that time. Increase the temperature gradually from room temperature, record multiple sets of data. Note to take more data points in the region where the slope changes rapidly.
- 5) Plot  $V$ - $T$  curve using the recorded data, and calculate Curie temperature of the sample.
- 6) Measure different samples or respectively use heating and cooling methods to measure and analyze experimental results.

## 7. An example of data recording and processing

Note: Following data are for reference only, not the criteria for apparatus performance:

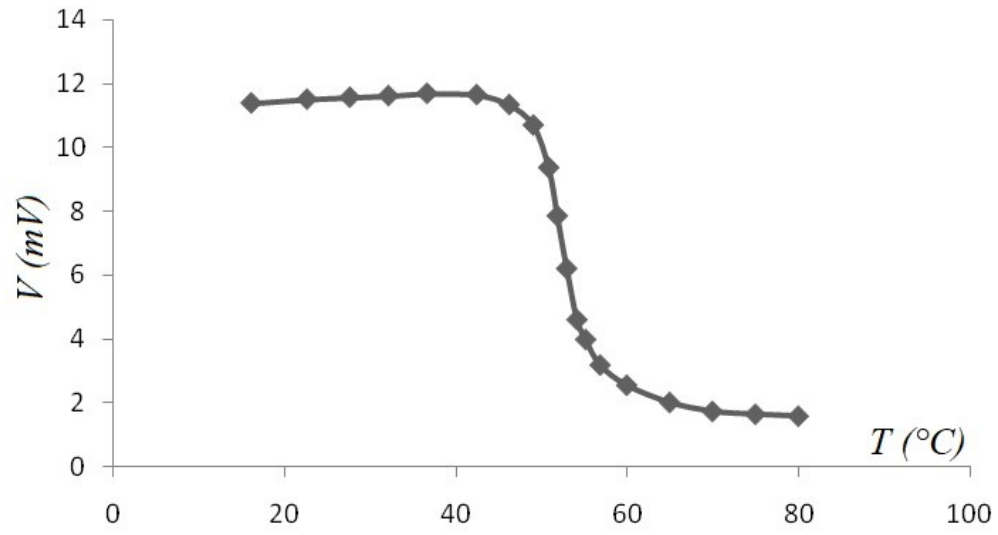
Ferrite sample with reference Curie temperature at  $50\text{ °C} \pm 2\text{ °C}$ .

Following the experiment procedures described above, data were recorded in the table below

Table: Output voltage and heating temperature of a ferrite sample

$T\text{ (°C)}$	16.1	22.6	27.6	32.1	36.6	42.4	46.2	49.0	50.8	51.8
$V\text{ (mV)}$	11.38	11.50	11.56	11.61	11.68	11.64	11.33	10.69	9.36	7.85
$T\text{ (°C)}$	52.9	54.1	55.1	56.8	59.9	64.9	69.9	74.9	79.9	
$V\text{ (mV)}$	6.20	4.60	3.98	3.18	2.55	2.01	1.73	1.64	1.58	

The V-T curve is plotted as follows based on the recorded data:



From the  $V$ - $T$  curve, the Curie temperature of this sample can be found at around 51  $^{\circ}\text{C}$ .