QTC I-V curve

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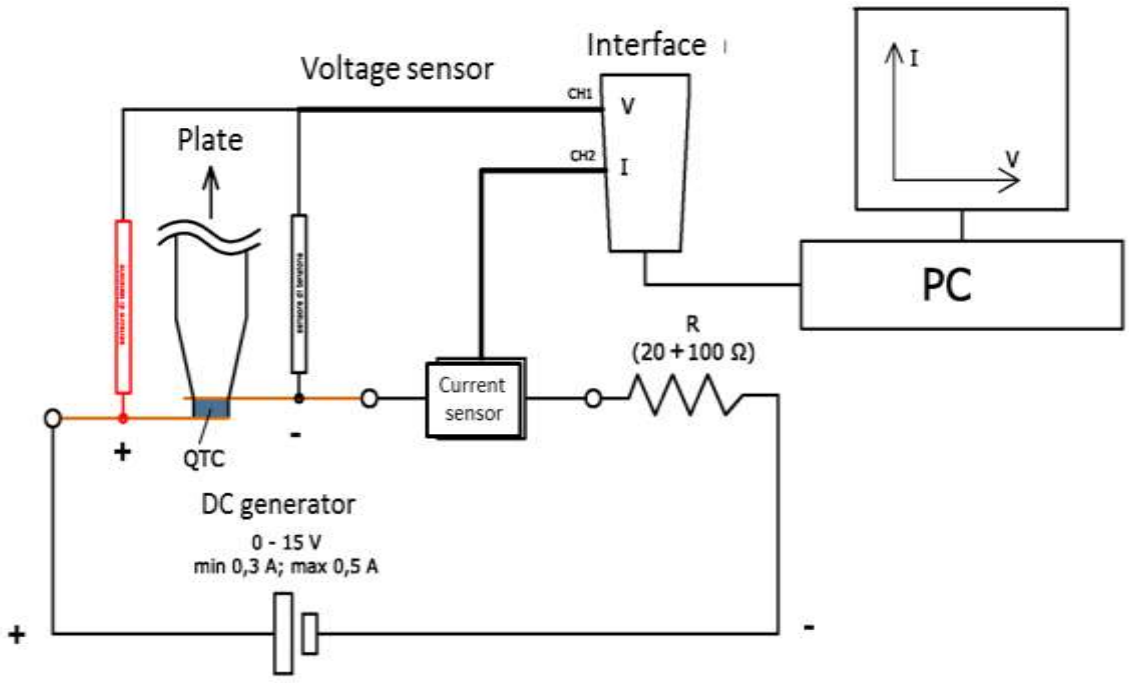
Your task in this lab activity is to plot and investigate I-V curves of piezoresistive samples (QTC©, Velostat, etc...) in order to find experimental evidence of the different charge transport mechanisms.

Equipment

- Campioni di QTC, Velostat, (Eon-Tex)
- Same gear for compressing apparatus as listed in student sheet 1
- Power pack
- Current probe
- Voltage probe
- Sensors/PC interface *Lab pro*
- Software *Logger pro*
- Computer
- Resistence (20 /100 Ω) optionale
- 4 connecting cables
- 2 crocodile clips cable ends
- Lab masses (or sand)

Procedure

Build the circuit shown in the picture: the current sensor in series and the voltage one in parallel .



1. First thing decide which initial mass to apply. It will not be changed throughout the data collection and will determine the initial resistance R_0. Write down M_0 and R_0
2. Check the sensors range and be careful never to exceed it!
3. Keep only one graph window open (I current, on the y-axis and V voltage on the x-axis). You will be able to see the IV curve plotted in real time.
4. Start the on-line data collection.
5. Turn on the power pack and slowly increase the applied voltage with small steps.
6. Once you have reached the maximum value of V go backward and complete the curve by progressively decreasing the applied voltage.
7. When V is zero again switch the power off and stop the data collection.
8. Save the data and paste it in a spreadsheet; cut and paste the graph too (you can use the " Print screen " option).

Further investigation

1. **Comparing I-V curves**:

Plot the typical I-V curve for an ohmic resistance. Are there any differences with the I-V curves of the piezoresistive samples? What about R?

2. The conductive mechanism of QTC© is mainly based on **electron quantum tunneling** through the polymeric film enfolding the nickel particles. Which aspects in the IV curve can be experimental evidence of this. Why?

Hints and tips:

- *Observe the initial and final resistance: draw the tangents to the initial and final parts of the curve in the origin and compare the two inclines.*
- *Is R always positive ?*
- *Are the two paths of the curve (back and forth) completely overlapping?*

3. Running the cycle repeatedly

Repeat 2 or 3 times the data collection consecutively (=without turning off the sensors) and investigate how the I-V curve modifies at each cycle. Give a possible interpration for what's happening.

4. Varying the applied pressure

Repeat the measurements with the same sample but changing the applied mass.