**Pre-Lab:**

**Characterization of Aluminum Coated Plastic**



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1. **Introduction**

**The goal of this experiment is to test the conductivity of an aluminum coated plastic material as well as analyze its physical properties.**

**Part 1:**

In our research involving the automatic generation of PCB traces for the Robot Compiler created robot body designs, we have found it necessary to understand the specifics of the materials that are planned to be used. It is imperative to know that the aluminum coated plastic we wish to use will have a certain value of conductivity as well as resistivity.

We want to exactly focus on the measured resistance of strips of this metal and compare these values to the theoretical values. Using the calculations for resistivity we can easily obtain the conductivity by taking the inverse of the measured resistivity value.

Perhaps this material is not the best to use for our purposes and in that case this experiment will need to be repeated with a different material that best meets our needs.

**Part 2:**

In addition, we wish to analyze the physical properties of this material to be able to answer the following questions:

* What happens to the metal when it is folded?
* Will it still act as a wire?
* Does it create a short circuit when voltage is applied?

**II. Components**

The components that are required to conduct this experiment are the following:

* Aluminum coated plastic
* Digital Multimeter
* Paper cutter
* 3.7 Volt Battery

**III. Experiment Setup/Procedure**

**Part 1:**

1. Use paper cutter machine to cut the aluminum coated plastic into 10 different pairs with the following measurements: 2cmx3cm, 2cmx4cm, 2cmx5cm, 2cmx6cm, 2cmx7cm, 2cmx8cm, 2cmx9cm, 2cmx10cm, 2cmx11cm, and 2cmx12cm. We would need two trace patterns of each measurement (one for power and one for ground).
2. Grab digital multimeter and grab the first pair of aluminum coated plastic that is 2cmx3cm
3. Position each rectangle next to each other, make sure they do not touch and the aluminum side is facing upwards.
4. Using the multimeter, touch each rectangle (simultaneously) with each of the probes
5. Make sure the digital multimeter is measuring resistance, then write down the resistance measured in the results table. NOTE: if resistance is 0, you are probably using plastic side, so flip it over and measure again
6. Repeat steps 2-5 for each of the different pairs of aluminum coated plastic (2cmx4cm, 2cmx5cm, 2cmx6cm, 2cmx7cm, 2cmx8cm, 2cmx9cm, 2cmx10cm, 2cmx11cm, and 2cmx12cm).

**Part 2:**

1. Grab the pairs with lengths 2cmx8cm, 2cmx9cm, 2cmx10cm, 2cmx11cm, and 2cmx12cm.
2. For each of the pairs, fold each piece of material and answer question 1 under the section labeled “Part 2 Experiment Questions.”
3. Grab the 3.7v battery and make contact with each of the folded pairs of aluminum coated plastic
4. Using the digital multimeter make sure setting is set to continuity
5. touch the black probe to our ground and the red probe to our wire, if there is a very low resistance this means we have a short.
6. From observations in step 5 answer questions 2 and 3 under “Part 2 Experiment Questions”

Note: Resisitivity of Aluminum is 2.8 x $10^{-8}$ Ω\*m

R=$\frac{ρL}{A}$ where ρ= resisitivity of the conductor material, R=resistance of conductor, L=length of conductor, A=cross-sectional area of conductor.

**Results Table:**

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| --- | --- | --- | --- | --- |
| **Dimensions** | **Measured Resistance of Aluminum using Ohmmeter (Ω) Strip 1** | **Measured Resistance of Aluminum using Ohmmeter (Ω) Strip 2** | **Average Measured Resistance of Aluminum (Ω)**  | **Theoretical Resistance Value Aluminum(Ω):** |
| 2cmx3cm |  |  |  |  |
| 2cmx4cm |  |  |  |  |
| 2cmx5cm |  |  |  |  |
| 2cmx6cm |  |  |  |  |
| 2cmx7cm |  |  |  |  |
| 2cmx8cm |  |  |  |  |
| 2cmx9cm |  |  |  |  |
| 2cmx10cm |  |  |  |  |
| 2cmx11cm |  |  |  |  |
| 2cmx12cm |  |  |  |  |

**Results Graphs:**

In order to find resistivity, we can see that we will need to plot resistance on the y-axis and length of wire material on the x-axis. This will yield a slope of resistivity/cross-sectional area. Plot this graph and include it in the space below:

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| --- |
|  |

Next we will generate a graph with Resistance on the y-axis and the ratio of length to cross-sectional area on the x-axis. The slope of this best-fit line will yield the Resistivity. Include graph in the space below:

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| --- |
|  |

Resistivity value (slope):

Conductivity value (inverse slope):

**Part 2 Experiment Questions:**

1. What physically occurs to material when it is folded?

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|  |

1. If we apply a voltage and fold it, does it create a short circuit?

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|  |

1. If we fold the material and apply a voltage, will it still function as a “wire”?

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|  |