Graphene Heat Transfer: Investigating Thermal Change in Coated Polyethylene

Purpose

To explore how the thickness of a graphene coating impacts the rate of heat transfer along black polyethylene strips when exposed to consistent heat.

Background

Graphene is a single layer of carbon atoms that, though very thin, is incredibly strong and known for its thermal conductivity. When applied to other materials, it can significantly alter how heat flows across a surface. In this lab, you will explore how the thickness of the graphene coating affects the speed at which heat travels along strips of polyethylene. You will measure the time it takes for one side of the material to reach a set temperature.

Hypothesis

Predict how the thickness of the graphene coating will affect the speed at which heat will travel along the polyethylene strip

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Materials (per group)

- 3 black polyethylene strips (4 inches long, same width/thickness. Each coated with graphene film: 0.2 mm, 0.4 mm, and 0.7 mm)
- Heat lamp
- Infrared thermometer or temperature-sensitive stickers
- Stopwatch
- Ruler
- Masking tape
- Lab stand with clamp (to hold the lamp in position)
- Graph paper

Procedure

1. Place the 0.2 mm graphene-coated strip flat on the lab bench.
2. Use masking tape to mark 1-inch intervals (1", 2", 3", 4") along the strip.
3. Position the heat lamp 5 cm above the end of the strip **closest** to the 1” mark. Keep it consistent for all tests.
4. Turn on the lamp and start the stopwatch.
5. Use the thermometer to record how long it takes each inch mark (1" to 4") to reach a target temperature (e.g., 35°C).
6. Record your times in the data table.
7. Repeat steps 1–6 for the 0.4 mm and 0.7 mm graphene-coated strips.

Data Table

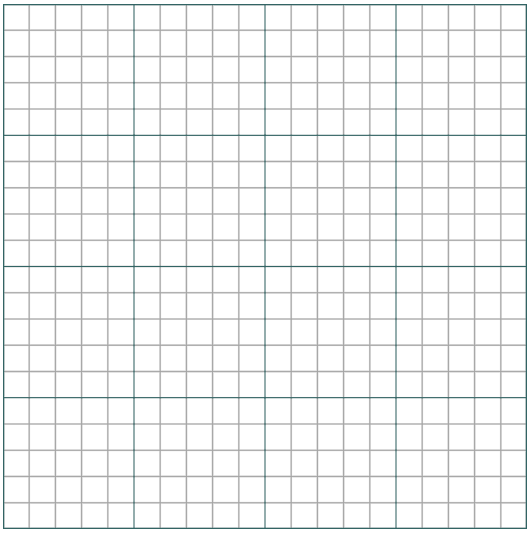
Graphene Thickness (mm)	Time to 35°C at 1" (sec)	Time to 35°C at 2" (sec)	Time to 35°C at 3" (sec)	Time to 35°C at 4" (sec)
0.2				
0.5				
0.7				

Graphing

On graph paper below, create a **line graph**.

- **X-axis:** Distance along the strip (in inches)
- **Y-axis:** Time to reach 35°C (seconds)

Plot **three separate lines** on the same graph, one for each graphene thickness. Label each line.



Analysis & Inquiry Question

- How did the graphene thickness affect how quickly heat traveled along the strip?
- Which thickness allowed for the fastest heat transfer? Why might that be?
- Was the heat transfer rate consistent across the strip? How do you know?
- What real-world applications could benefit from materials with faster or slower heat transfer?
- If you repeated this experiment with different base materials, such as metal or a composite, what do you predict would happen?

Conclusion

Based on your results, summarize the relationship between graphene thickness and heat transfer speed across the strip.

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