

How To Make Conductive Graphite Paint

Overview:

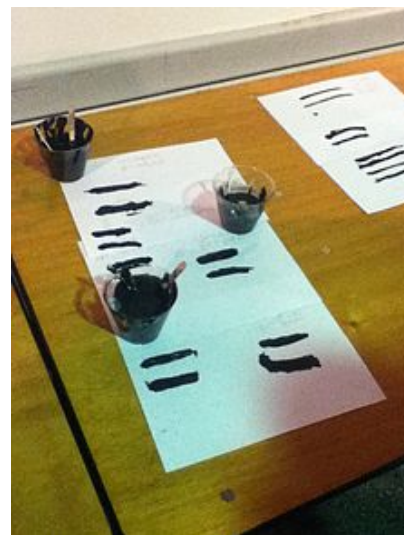
Students create and test electrically conductive paint containing graphite.

Essential Question:

How can paint be made to conduct electricity?

Background:

Graphene and graphite are crystal allotropes of carbon which also conduct electricity. Graphite powder can be mixed with a binder such as acrylic glaze to make a conductive paint that can be used in solar and battery projects. A commercial version of this material is known as wire glue used for no-solder electrical connections. This is a nice materials science problem because there are many variables that can be changed which affect the conductivity and ease of use of the final product. Coming up with a standard, repeatable method of measuring resistance is also required.



Research Connection

Researchers are creating new conducting materials similar to graphene that are just a few atoms thick. These materials can be used as conductors or semiconductors in circuits. This creates the opportunity to make nano-scale electronic devices which are also fast and energy efficient. New batteries are being designed that use thin film conductors.

NGSS Standards:

Standard Number	Standard text
CCC	Structure and function
SEP	Planning and carrying out investigations
MS-ETS1-3	Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

Materials

- Graphite powder-
- Acrylic Glazing Liquid
- Mixing Container
- Coffee stirrer
- multimeter

Procedure

- 1) Add 2 teaspoons of graphite powder to mixing container
- 2) Add a teaspoon of acrylic glaze

- 3) Mix thoroughly until it is completely uniform
- 4) Apply lid or transfer to airtight container.
- 5) Follow the testing procedure below, revise your formula or methods and try again.

Testing

Use a paintbrush or stirring stick to apply a piece of cardboard, let it dry.

Measure the resistance with an ohm meter in the 100s of ohms range. You should be able to see that the resistance increases with the length of the conductor path. Practice making a uniform paint line then measure the resistance of the line in ohms per millimeter. You may also be able to measure that a larger cross section of conductor has less resistance. Try applying the paint as a thin film on a conductor.

Variations

Polyvinylpyrrolidone (PVP) is an adhesive found in glue sticks. It can be dissolved in water to produce and mixed into the graphite paint mixture.

You can make repeated measurements of resistance at different distances on a painted line, on lines of different widths. Graph the results to show that resistance increases with length and decreases with wider lines.

Try making conductive dough and squishy circuits.

Resources:

<http://courseweb.stthomas.edu/apthomas/SquishyCircuits/buildingCircuits.htm>

<https://www.exploratorium.edu/tinkering/projects/squishy-circuits>

Sources:

- Polyvinylpyrrolidone (PVP) ...https://www.amazon.com/MakingCosmetics-PVP-4-4oz-125g/dp/B01GD6GC9C/ref=sr_1_1_a_it?ie=UTF8&qid=1483028386&sr=8-1&keywords=polyvinylpyrrolidone
- Graphite powder- 6 oz \$11 https://www.amazon.com/Generals-Powdered-Graphite-6-oz/dp/B00TCLCO7A/ref=sr_1_2?ie=UTF8&qid=1481848271&sr=8-2&keywords=graphite+powder
- Acrylic Glazing Liquid 8oz \$10 https://www.amazon.com/Golden-Acrylic-Glazing-Liquid-Gloss/dp/B005Z3XWH0/ref=sr_1_1?ie=UTF8&qid=1481848321&sr=8-1&keywords=acrylic+glaze+gloss
- Wire glue https://www.sciplus.com/conductive-wire-glue-41172-p?gclid=EAIaIQobChMI0IH6LHD3wIVk6DsCh2D1QXsEAQYAIAiABEgK44PD_BwE