

Exploring Fabrication— Electroplating

*How can scientists make a nickel
look like a penny?*



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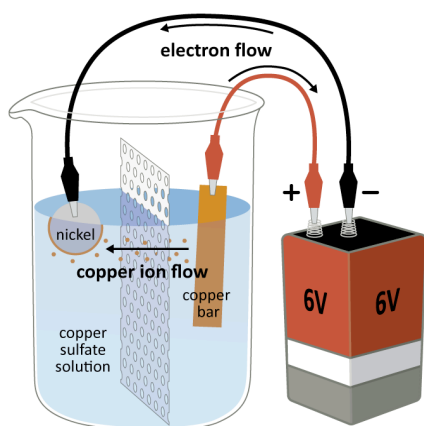
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Try this!

1. Wearing safety goggles, connect the nickel coin to the negative side of the battery (using one alligator clip) and the copper bar to the positive side (using the second alligator clip).
2. Dip both the nickel and the copper bar into the salt solution. (Make sure they do not touch each other!) What do you notice?
3. Now take the coin and the copper out of the salt solution. What changed?



What's going on?



Copper electroplating

The nickel coin changed color because it now has a thin layer of copper on it. When the copper bar and nickel coin are connected to the battery and placed in the salt solution, you complete an electrical circuit. The electricity from the battery removes copper from the surface of the copper bar and deposits it onto the surface of the nickel. This process is called **electroplating**. The longer you keep the circuit connected, the thicker the layer will be.

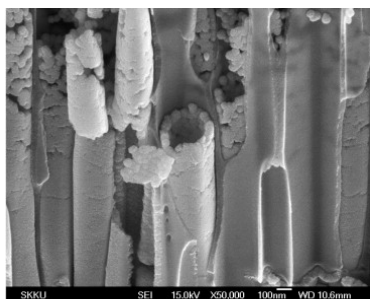
The blue solution is copper sulfate (CuSO_4) in water. When solid copper sulfate is dissolved in water it breaks up into two ions, Cu^{2+} and SO_4^{2-} . These ions allow electric current to flow through the liquid.

When the current is flowing from the battery, the reaction at the copper bar converts copper metal (Cu), which has no electric charge, to copper ions (Cu^{2+}), which have a positive charge.

These copper ions travel through the solution to the coin connected to the negative side of the battery. The copper ions turn back to metallic copper and bond onto the coin. The copper ions present in the copper sulfate solution plate onto the coin, and the reaction at the copper bar continually replaces the copper ions in the solution allowing the plating to continue as long as the circuit is connected and there is still copper available.

Copper is just one of many metals used for electroplating. Other examples include zinc, gold, silver, and platinum. Electroplating is used for a variety of reasons such as making thin protective layers on cars or planes or coating jewelry with precious metals like gold.

How is this nano?



Electroplated nanotubes

Scientists use special tools and equipment to work on the nanoscale. The electroplating process can deposit nanometer-thin layers of material. (A nanometer is a billionth of a meter.) Researchers can reliably control how thick the electroplated layer is by carefully controlling the current flowing through the circuit.

Electroplating is a simple, low-cost process scientists can use to create thin films, coating, nanowires, and other nanoscale structures.