Title of video: Homemade zinc-copper battery

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Description:

This experiment is a quick and simple way of visualizing how batteries and their individual electrochemical cells work.

For more than two centuries, since its invention by Alessandro Volta, batteries have been used for a plentitude of things, from storing electric energy to powering everyday devices.

This particular one consists of a battery with six galvanic zinc-copper cells connected with each other.

With it we'll power up an LED and verify its power with a multimeter.

Concepts:

A galvanic cell consists of a device in which electric current is produced, from an oxidation-reduction reaction. This battery uses several galvanic cells, in which an oxidation-reduction reaction happens between zinc and copper.

Because of the acidity of the acetic acid present in the vinegar, both the zinc and the copper react with it. The zinc reacts with the acetic acid, forming zinc acetate and hydrogen ($2\ HC_2H_3O_2\ (aq) + Zn\ (s) \rightarrow Zn(C_2H_3O_2)_2\ (aq) + H_2\ (g)$). This is the oxidation of the zinc $Zn\ (s) \rightarrow Zn^{2+}\ (aq) + 2e^-$. Now, in the solution, there are zinc ions ($Zn(C_2H_3O_2)_2$), specifically Zn^{2+}.

The copper oxide in the washers reacts with the acetic acid, forming copper acetate and water ($CuO\ (s) + 2CH_3COOH\ (aq) \rightarrow Cu(CH_3COO)_2\ (aq) + H_2O\ (l)$). Now there are copper ions in the solution $Cu(CH_3COO)_2$, specifically Cu^{2+}. These ions react with the electrons from the zinc oxidation and a reduction happens $Cu^{2+}\ (aq) + 2e^- \rightarrow Cu\ (s)$.

Combining the reduction and the oxidation, we get an oxidation-reduction reaction between the zinc and the copper ions, which creates a flow of electrons from the zinc washer (anode) to the copper washer (cathode).

Experimental protocol:

Security:

Just like with every other experiment, a lab coat and gloves should be used for protection.

Extra caution is advised while handling the box cutters.

Reagents:

- Vinegar
- 5 zinc washers
- 5 copper washers;

Material:

- Sponge;
- Box cutters;
- Beaker;
- 4 small clothes pins;
- Red LED;
- Connecting wires;
- Multimeter with respective wires;

Procedure:

1. Cut the sponge into 5 small identical pieces with the box cutters. Use caution while using the box cutters;
2. Fill the … beaker with vinegar;
3. Submerge the sponge pieces in the vinegar for a few seconds;
4. Insert one zinc washer and one copper washer per sponge piece, on opposite sides;
5. Connect all the sponge pieces in series with the clothes pins, connecting a zinc washer to a copper washer. Make sure that no washer touches the sponge it's not in, so it doesn't short circuit;
6. Connect the long leg of the LED to the last copper washer and the short leg to the zinc washer, using the connective wires;
7. To verify the current, connect the multimeter to the battery. The zinc washer to the negative connection and the last copper washer to the positive connection.

Applications:

This experiment serves as a simple explanation to how electrochemical cells work.

Besides educational purposes, this battery serves as a temporary source of power and, by adding more or less cells to the battery, the voltage can be increased or decreased respectively, depending on demand.

Conclusion:

This simple, quick and cheap experiment was chosen because the group considers the electrochemical cell to be one of the most important inventions of all time. It's amazing how much we depend on it: from cars to computers to TV remotes, our lives would, put simply, be totally different without this very simple invention; and, with the ever expanding electronics industry, we're going to depend on them even more.