Aluminum Air Battery

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For this experiment, we wanted to try to assemble and test out an aluminum air battery. Before we begin, let's take a look at why this would work as a battery in the first place.

A battery is a device that converts chemical energy into electrical energy. This occurs because two chemical reactions are taking place: one that makes electrons and one that uses electrons. Batteries have electrodes that are made of dissimilar metals. Batteries are made from different metals since one of the metals likes to share electrons, and the other metal receives them. If both metals were the same material, the current would not flow. Batteries also need an electrolyte, which is a chemical medium that allows the flow of electric charge between the cathode (+) and anode (-) of the battery.

In this experiment the electrodes are the aluminum foil and the activated charcoal. The electrolyte in this experiment is a paper towel that was soaked in saltwater.

Why is activated charcoal used in this experiment? Activated charcoal is carbon that has been treated with oxygen, which causes the charcoal to be highly porous. Because it is extremely porous, it also has a large surface area that allows for the chemical reactions to occur. As you will see, these qualities will be beneficial to the experiment.

The materials needed to make the battery are:

- Aluminum foil
- Salt
- Cup
- Water
- Activated charcoal (can be purchased from most pet stores)
- Paper towel
- Two electrical leads with alligator clips

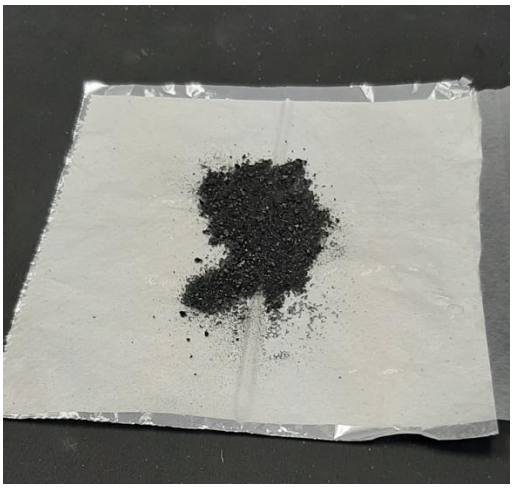
- Scissors
- Electrical tape
- A small hobby motor or LED
- A multimeter

1. The first step of the experiment is to mix a half cup of salt into a half cup of water.

2. The second step is to place the paper towel soaked in saltwater for at least a few seconds to make sure it is completely wet.

3. Then, place the paper towel on top of the square of aluminum foil, and place about 2-3 tablespoons of activated charcoal on top. You can see this in the picture below.

4. Finally, take two tablespoons of the saltwater and place it on top of the charcoal to make sure it is wet all the way through.

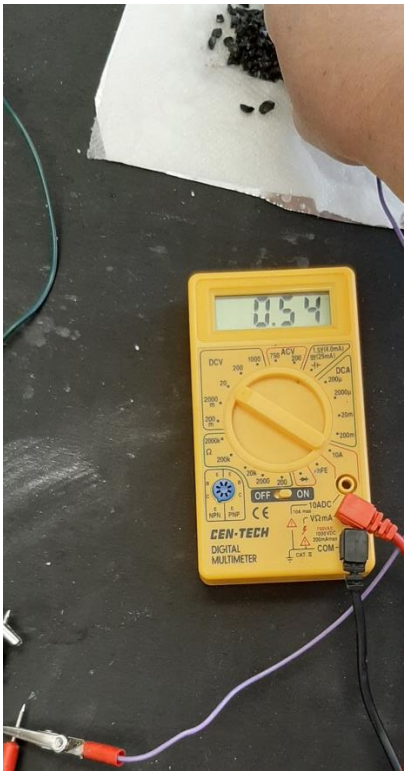


Aluminum foil, saltwater soaked paper towel, and pile of activated charcoal.

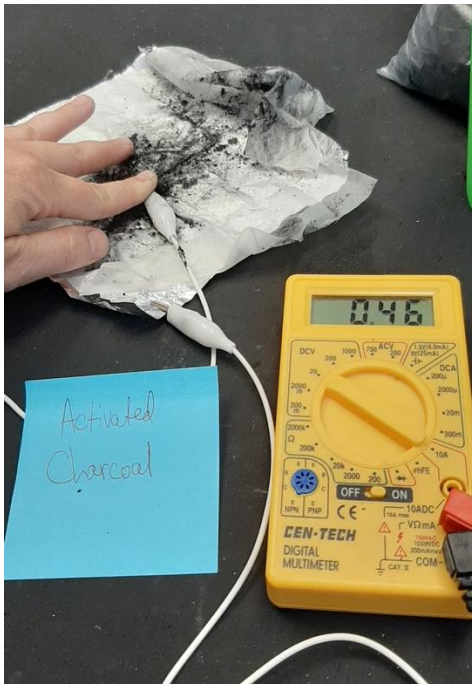
For the sake of experimentation, we set up three batteries to see if the form of charcoal made a difference. For one, we crushed some of the activated charcoal into a fine dust for one battery. For another battery, we used the charcoal as is, which was more of a gravel or granular consistency, and finally we crushed a charcoal briquette used for grilling that is non-activated.

Three different batteries; one with granular activated charcoal, crushed activated charcoal, and non-activated charcoal (a crushed charcoal briquette).

We used a multimeter to see how much voltage each produced. We clipped one of the alligator clips to the aluminum foil, and the other clip was on the multimeter lead. The second alligator clip goes on the other multimeter lead, and the last clip is pressed onto the activated charcoal. The results from each are below:



Granulated activated charcoal



Crushed activated charcoal

Non-activated charcoal

To run the battery, we clipped one of the alligator clips to the aluminum foil, and the other clip to terminal of the motor. The second alligator clip goes on the other terminal of the motor, and the last clip is pressed onto the activated charcoal. The links below show this process in action.

Click here to see what happens when we attach the hobby motor to the aluminum air battery made with granular activated charcoal.

Click here to see the aluminum air battery made with activated charcoal powder.

Click here to see the aluminum air battery made with non-activated charcoal.

Using the activated charcoal as is, in its original granular form, produced the most voltage. And although the non-activated charcoal produced the second highest voltage, when it was attached to the motor, it did not spin. Was this due to the lack of pores and surface area? This seems to be the case.

From this experiment, it was the activated the charcoal, whether it was crushed or granular, that allowed the motor to run.

What is Happening?

What can account for this? What is occurring is a chemical reaction with the aluminum foil and the saltwater that is oxidizing the aluminum and creating electrons.

Meanwhile, because the activated charcoal is so porous, it provides a surface for air to be reduced, which requires an electron. Electrons are created by the first reaction, the electrons travel through the wires and the motor, and they end up at the top of the activated charcoal.

The electrons in the aluminum travel through the electrolyte (the saltwater) and up to the cathode, which is the activated charcoal. The reaction that powers the battery occurs between the aluminum foil and oxygen from the air.

It could be that since the activated charcoal has more surface area and micropores compared to the non-activated charcoal, it made for the effective battery.

Challenge Us!

Think you have a better way to make this battery even more powerful? Try conducting this experiment yourself, or send suggestions for this and any future experiments you'd like to see by emailing us at: nem.education@gmail.com. We look forward to hearing from you!