Air Battery

Overview: It's easy to use chemistry to generate electricity, once you understand the basics. With this experiment, you'll use aluminum foil, salt, air, and a chemical from an aquarium to create an air battery. We'll be using a digital multimeter to find out just how much voltage your battery cell generates (and this will also tell you how many of these batteries you need to make to power a LED or motor.)

What to Learn: This "aluminum air battery" uses a chemical reaction between the foil and air (well, specifically the oxygen in the air). The combination of oxygen and foil produces aluminum oxide and energy. If you build your battery well, you can see the energy when this battery lights up an LED or turns a motor shaft, but the oxide layer will be invisible to your eye.

Materials

- salt
- bowl of water
- activated charcoal (from an aquarium supply store)
- aluminum foil
- paper towel
- 2 alligator clip leads

Lab Time

1. Fill your bowl with water.
2. Make a saturated salt solution by dissolving as much salt as you can into the water. When you start to see bits floating on the bottom, you've added the perfect amount.
3. Fold your paper towel in half and dip it in your solution.
4. Lay a sheet of aluminum foil on the table.
5. Pull out the towel and lay it on top of the foil.
6. Pour a layer of charcoal over the towel, about ½-inch thick. Completely cover the paper towel.
7. Remove the plastic insulation from one of the alligator clip lead so the metal head is completely exposed. (You may have already done this in your lab preparation.)
8. Lay the exposed lead in the middle of the charcoal pile.
9. Clip the second alligator clip lead onto one end of the foil, so that the wire is coming out of other end of the foil.
10. Roll the paper towel *first* around the exposed alligator lead. You don't want this lead touching the foil, but rather completely surrounded by the charcoal. Wrap it up and then wrap the foil around it like a large burrito with one wire sticking out of each end.
11. Close the ends off so you don't leak carbon bits everywhere.
12. Connect the free alligator clip lead ends to your DMM.

13. Turn on your DMM to 20 V DC. What do you read? (Don't forget to write "volts" after your number!)

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14. Squish the battery to make good contact between the carbon, salt, and foil. Your voltage should change when you do this.
15. If your answer is higher than 2.5V, then try using this in place of your battery pack and attaching an LED in a simple circuit.
16. If it's less than 2.5 volts, you'll need to team up with another lab group and hook your batteries up together to generate enough power. Here's how:
    a. Connect the alligator clip lead attached to the foil on your battery to the alligator clip lead coming from the center of their battery.
    b. Connect your probe to their foil alligator wire.
    c. You should still have the other probe attached to the alligator wire coming from the center of yours. If not, hook it up.
    d. What do you read?_____

Reading

This "aluminum air battery" uses a chemical reaction between the foil and air (well, specifically the oxygen in the air). The combination of oxygen and foil produces aluminum oxide and energy. If you build your battery well, you can see the energy when this battery lights up an LED or turns a motor shaft, but the oxide layer will be invisible to your eye.

Your battery should last between 4 – 10 minutes, depending on how well you build it. You can get a larger amount of voltage by using larger wires (with more surface area contacting the charcoal). What do you have that would be a larger electrode for the battery?

The more salt you use, the better your air battery will work! You'll notice there's a point, though, where no matter how much more salt you add, you can't increase the voltage… due to the saturation point of the water. It's better to have an over-saturated solution (meaning that there are still bits at the bottom of the bowl). You can heat the water to increase its capacity to dissolve the salt.

Exercises

1. How many air batteries does it take for your LED to light up?

2. Which electrode is positive? Which is negative? (Hint: Use the DMM to figure this out.)

3. What is the electrolyte in this experiment?

4. What could you use instead of an exposed alligator clip lead to make this battery last longer?

Answers to Exercises: Air Battery

1. How many air batteries does it take for your LED to light up? (Check data results.)
2. Which electrode is positive? Which is negative?
3. What is the electrolyte in this experiment? (Salt water.)
4. What could you use instead of an exposed alligator clip lead to make this battery last longer? (Zinc, copper…etc.)