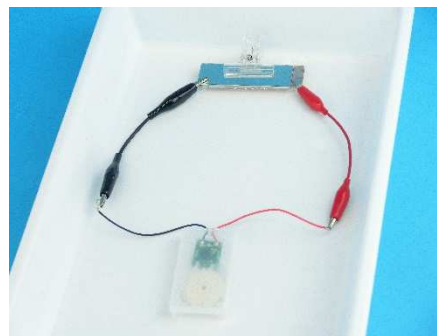
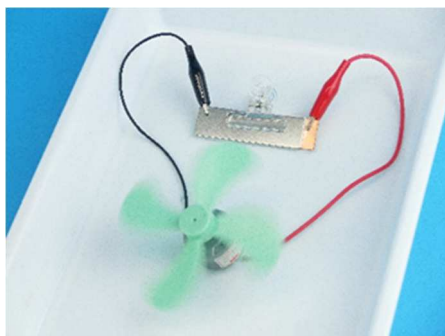


Layered Assembly Type Daniell Cell

Cat. No. B10-2016-W0



Aug 2022

Safety Precautions

- Wear safety glasses and safety gloves during experiments.
- Instruct students about the operating procedure and the safe ways of conducting experiments with this product prior to experiments.
- Always carry students' experiments under the supervision of teachers/trainers.
- Be careful with chemicals. Wash thoroughly with large amount of water immediately if it enters one eye and/or adheres to the body.
- Instruct students to carry their experiments in plastic trays to protect themselves and their surrounding from chemicals used.
- Read thoroughly Safety Data Sheet (SDS) of copper sulfate and Zinc sulfate beforehand for your students' safety.

Introduction

Product's Feature

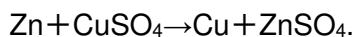
Easy to assemble kit for a layered Daniell Cell specialized for students' experiments that requires only a minimal amount of each solution absorbed by paper filters. Intended to minimize the amount of chemicals used in Daniell cell experiments. On average, the amount of zinc sulfate solution and copper sulfate solution used in students' experiment with Daniell cell is roughly 200mL each. By contrast, the product achieved easier and minimized waste disposal after the experiment by using two small size paper filters soaked with a few drops of electrolyte solution (not more than a few milliliters). The waste treatment is completed when the used paper filters are dried out and disposed of.

Background Information on Daniell Cell

Before Daniell cell was invented by John Frederic Daniell in 1836, Voltaic cell was commonly used in labs. However, the lifetime of Voltaic cell was not long enough for lab use due to hydrogen generated and accumulated around the copper plate, ultimately, acting as an insulator for electron transfer. To improve its lifetime, J.F. Daniell invented a new type of chemical cell, namely Daniell Cell. Daniell cell has a battery formula as shown below:



Chemical reaction taking place in Daniell cell is expressed as follows. Daniell cell theoretically generates electric voltage of 1.07 V when each electrolytic solution has the same concentration.



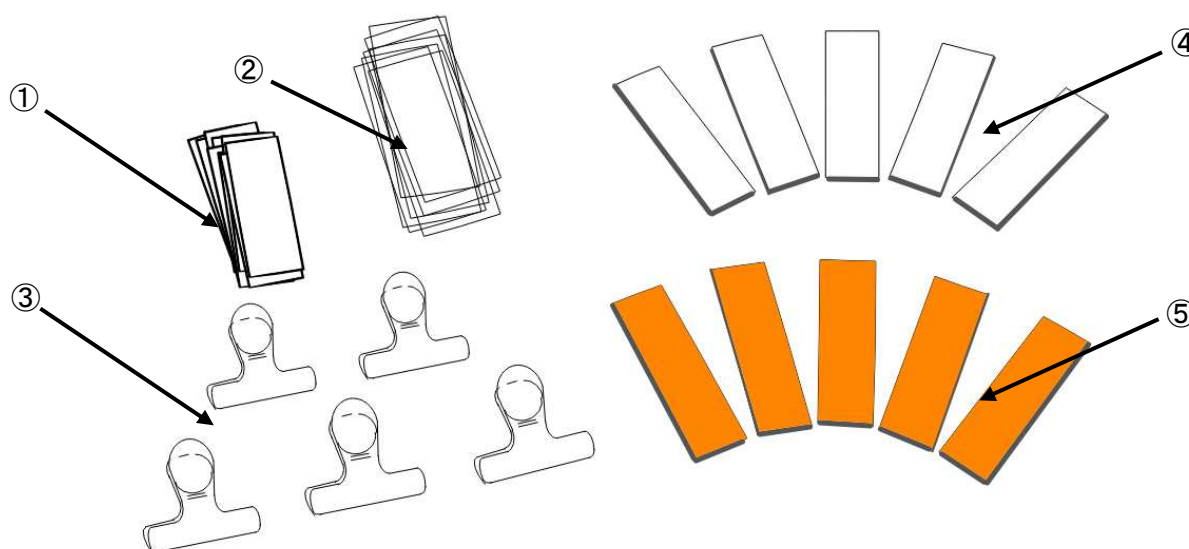
Daniell cell uses a porous plate (biscuit) as the separator between zinc sulfate solution and copper sulfate solution, which significantly differentiates Daniell cell from Voltaic cell. The separator prevents copper ions from directly contacting the zinc metal. Thus, the chemical reaction proceeding in Daniell cell is under control. When both electrodes are connected with each other by a lead wire, electron starts to travel from one electrode to the other as the chemical reaction starts. Then, zinc ionization and dissolution take place in zinc sulfate solution, whereas precipitation reaction of copper takes place in copper sulfate solution.

Chemical reactions occurring at each electrode of Daniell cell are expressed as follows:



Through the reaction, Zn ion increases at the negative side, whereas Cu ion decreases at the positive side. If the two types of the electrolyte solutions were completely separated, the chemical reaction wouldn't start. This is why Daniell cell needs a porous plate to separate the two solutions while allowing the flow of sulfate ions. This product achieved downsizing by using a semipermeable membrane instead of a conventional porous plate.

Contents



① Paper Filter: 60 x 20 mm, 40 pcs

② Semipermeable membrane film (Cellophane): 80 x 30 mm, 20 pcs

③ Bulldog clip (plastic): 5 pcs

④ Zinc metal plate: 20 x 70 x 1mm, 5 pcs ⑤ Copper metal plate: 20 x 70 x 1mm, 5 pc

How to use

Preparation

1. Prepare chemicals for the experiment

Prepare zinc sulfate solution and copper sulfate solution beforehand as they are not included in this product. Recommended concentrations of zinc sulfate solution and copper sulfate solution are 7% and 14% respectively. Prepare 40 mL of each solution for the experiment.

2. What else is needed:

- *Dropper or eye drop bottle
- *Safety goggles
- *Lab ware,
- *Safety gloves
- *Plastic tweezers
- *Plastic tray (recommended size A4, shallow type)
- *Lead wires with clips
- *Electric melody or small DC motor for low voltages.

How to assemble a Daniell Cell

- In a plastic tray, stack a piece of paper filter on a copper metal plate right-aligned (Fig. 1 & Fig. 2). [Tips:] Line up one shorter side of the paper filter and that of the copper metal plate (Fig. 2).
- Soak the entire surface of the paper filter with roughly five drops of copper sulfate solution using a dropper or dropper bottle. Do not add more than five drops, otherwise the total amount of solution will exceed the water retention capacity of the paper (Fig. 3) and it would spill.

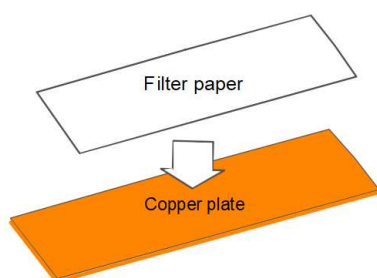


Fig. 1

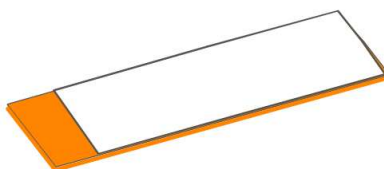


Fig. 2

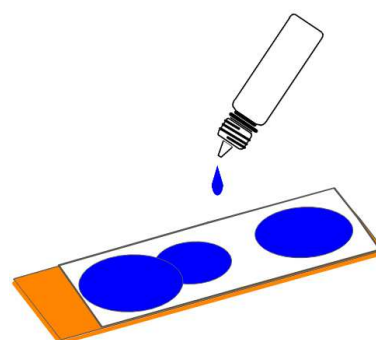


Fig. 3

- Cover entire surface of the soaked paper filter with a piece of semipermeable membrane film (Fig. 4).
- Stack another piece of paper filter on the semipermeable membrane film with no gaps with the soaked paper filter (Fig. 5).

5. Soak the entire surface of the paper filter with roughly five drops of zinc sulfate solution using a dropper or dropper bottle. Do not add more than five drops, otherwise the total amount of solution will exceed the water retention capacity of the paper (Fig. 6) and it would spill.
6. Stack a zinc metal plate on the upper paper filter, by putting it on the filter left-aligned, so that these two metals are not directly in contact with each other (Fig. 7).
7. Clip the whole layers with a bulldog clip (Fig. 8).

Assembled Daniell cell has five layers structure including two metal plates. Each of them can be clipped with a lead wire (black/red) respectively (Fig. 9).

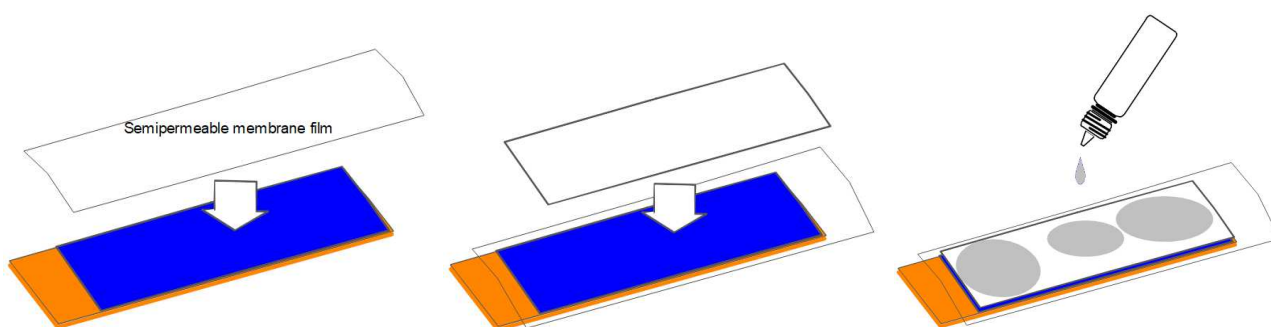


Fig. 4

Fig. 5

Fig. 6

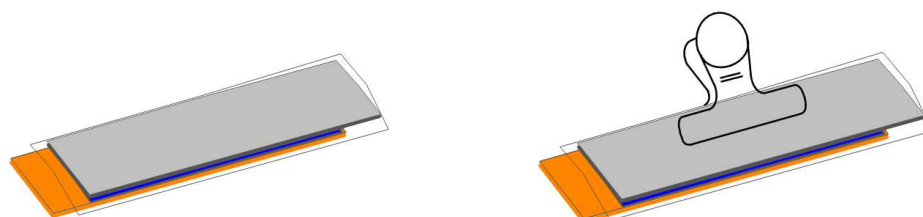


Fig. 7

Fig. 8

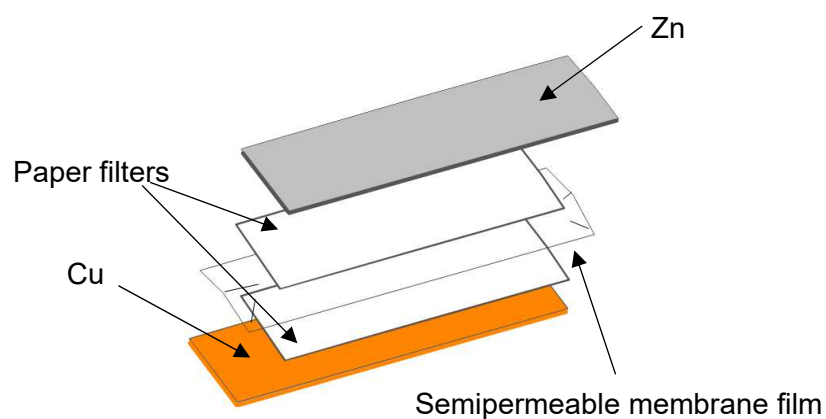


Fig. 9

Connect an assembled Daniell cell with an Electric melody or a Small DC motor with a propeller:

Make a closed electric circuit by connecting an assembled Daniel cell with an Electric melody or a Small DC motor with a propeller via two lead wires (not included in the product) and connect to (Fig. 10 & Fig. 11).

[Tips:] Recommended accessories for this experiment are Narika's "Electric melody" (Cat. No: P70-3939-W0, 1.2-3.6 V) and "Propeller motor" (Pacco series) (Cat No: P70-3946-03, 1.5-12V).

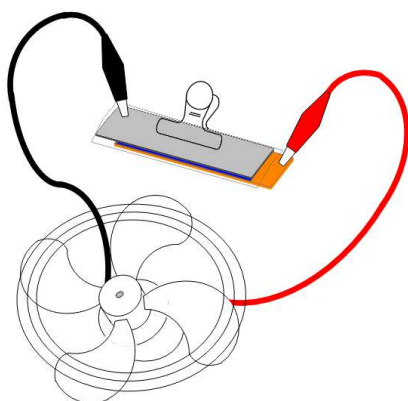


Fig.10

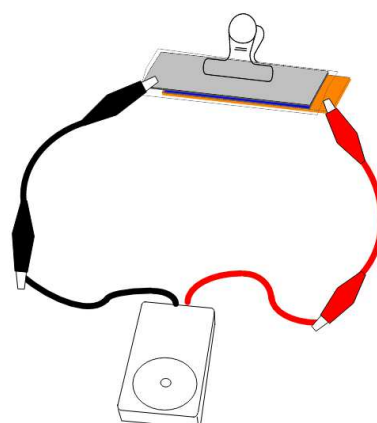


Fig.11

How to treat waste metal/paper:

1. Used metal plates (copper and zinc): In case they have crack(s), dispose of them following the local regulation. For reuse and/or store, wash, dry, and polish them immediately after the experiment.
2. Used paper filters and Semipermeable membrane films: Remove from the metal plates using tweezers and dispose of following the local regulations.

Troubleshooting

If a motor with a propeller or an electric melody fails to operate:

1. Check if each metal plate is cracked and/or corroded and replace with a new one.
2. Check the copper plate and zinc plate are short-circuited by directly contacting each other. If this is the case, disassemble the Daniell cell and assemble it again following the right procedure.

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