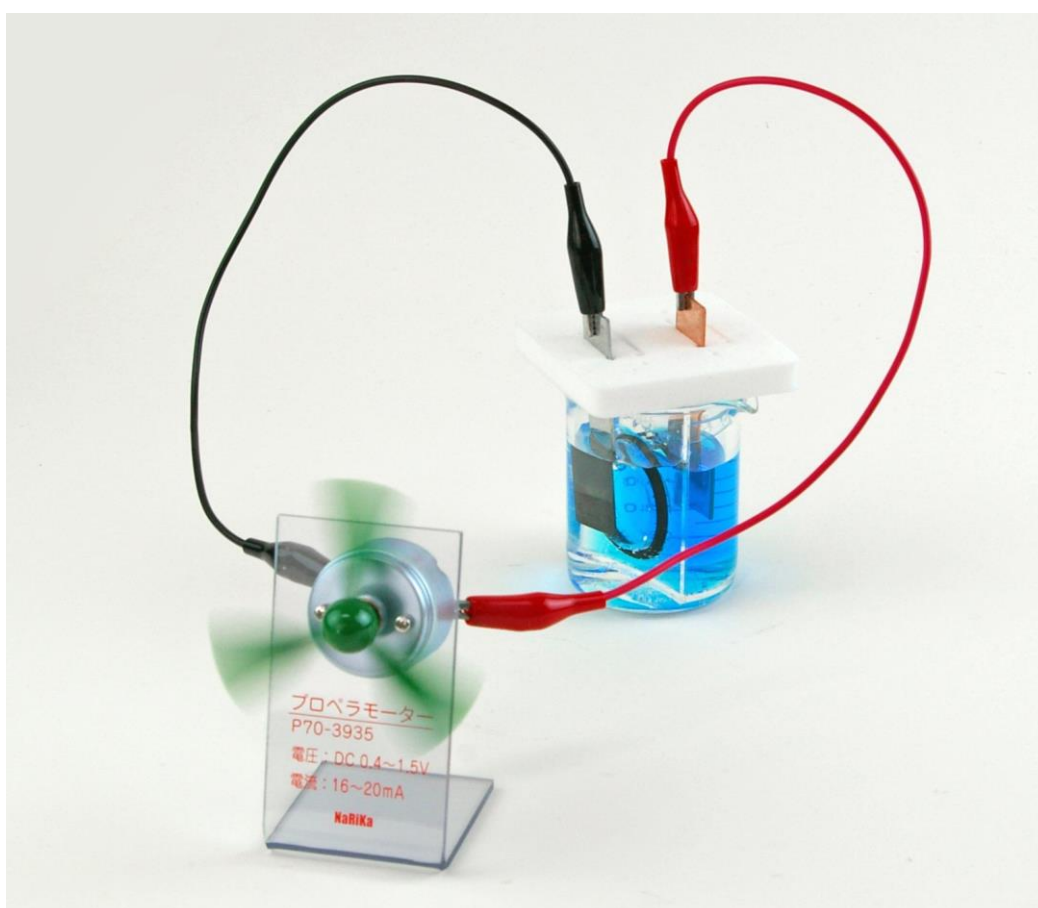


Daniell Cell Experiment Set

(Separate Cup Type) DT-B

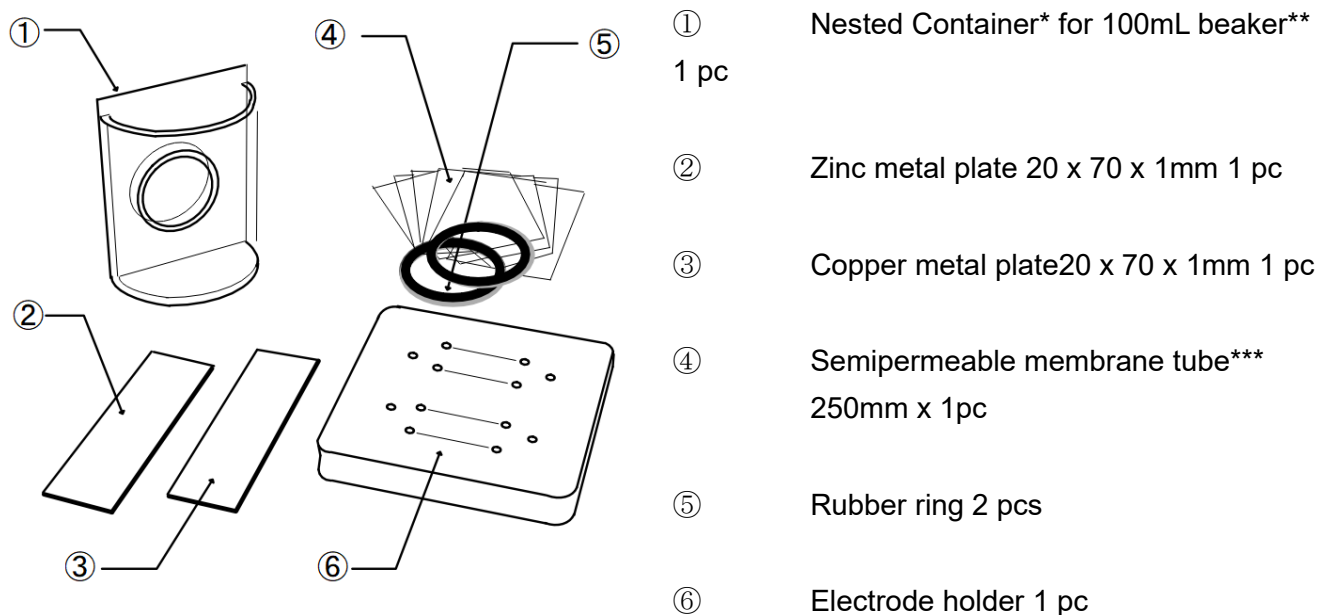
Cat. No.: B10-2013-W0



Cautions

- Wear safety glasses and safety gloves when you do experiments with this product.
- Do not conduct experiments with this product without your teacher.
- Instruct the experiment procedure before beginning the experiment.
- Be careful about chemicals, not to get them in your face to your hands or clothes. If that happens clean the affected area with water as soon as possible.
- Wash hands and face as soon as possible when chemicals attach to hands and face.
- Read and follow Safety Data Sheet (SDS) of Copper sulfate and Zinc sulfate for student's safety before conducting experiments.

Contents



* This container has been designed for Daniell cell experiments to save the volume of chemicals. It has been named the "Nested Container" and it separates the chemicals inside the beaker.

** 100mL beaker is not included in the set, therefore you need to prepare one piece beforehand.

*** Semipermeable membrane tube is a cellulose tube for dialysis.

Introduction

Purpose of the Product

The purpose of this product is to minimize the volume of using chemicals in Daniell cell experiments in schools. In general, when you experiment with Daniell cell for students in the school, you will usually use about 200mL of each Zinc sulfate solution and Copper sulfate solution. After the experiment, waste treatment and disposal is usually very complicated and takes time. Therefore, this product has been developed to make teacher's life easier, as it needs only a fraction of chemicals, thus being safer, less costly, preparation and cleanup time is shortened and other benefits.

Information about Daniell Cell

Before Daniell cell was invented, Voltaic cell was common. However, Voltaic cell had short life because hydrogen as an inhibitor occurs between Zinc and Copper. Daniell cell was invented to make a longer life than Voltaic cell. In 1836, J. F. Daniell invented the chemical cell which is called after him Daniell Cell. The cell has the following structure:



Chemical reaction equation is shown $\text{Zn} + \text{CuSO}_4 \rightarrow \text{Cu} + \text{ZnSO}_4$. Theoretical electromotive force is 1.07V when the concentration of each electrolytic solution is the same. Therefore, the reaction is same as a reaction between Zinc metal and Copper sulfate solution which produces Copper metal on the surface of Zinc metal. Daniell cell uses a porous plate (biscuit firing) as a separator between Zinc metal within Zinc sulfate solution and Copper metal within Copper sulfate solution. This is a big difference between Voltaic cell and Daniell cell. The separator inhibits Zinc metal and Copper ion from direct contact; therefore, its chemical reaction is controlled. When both electrodes are connected with each other by lead wire, electron starts to move from one electrode to another electrode, and the chemical reaction starts. Therefore, Zinc ionization and dissolution occur in its own solution, precipitation reaction of Copper in its own solution. Finally, Daniell cell is completed.

Chemical reaction at each electrode of Daniell cell is as follows:



In the reaction, Zn ion is increased at the negative electrode and Copper ion is decreased at the positive electrode. When the two kinds of electrolyte solution are completely separated, the chemical reaction stops. That is the reason that Daniell cell needs porous plate that allows ion transfer to the other side. This product uses a semipermeable membrane instead of the traditional porous plate in order to make a Daniell cell very small.

How to use

Preparation

1. Semipermeable membrane

1-1. Cut 5 cm of the semipermeable membrane tube and store the rest of the membrane for next experiment.

1-2. Soak the piece of a semipermeable membrane tube into the water. Then open it by cutting, thus making a film (see Fig. 1). It is hard to open the tube without any water because it very tightly sticks together. If you use the tube as it is, the experiment will fail due to its thickness.

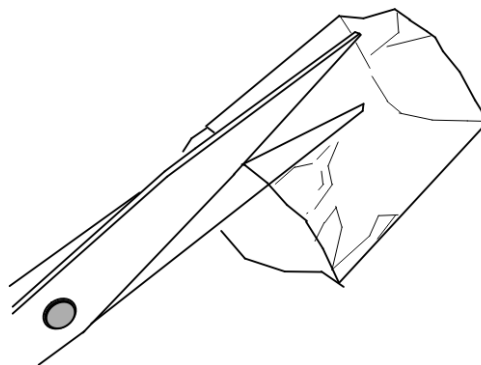


Fig. 1

2. Setup of "Nested Container"

2-1. Cover the hole of the Nested Container with the wet film from 1-2 and attach a rubber ring over the film to completely seal the hole.

2-2. Cut the excessive film (see Fig. 2 and Fig. 3).

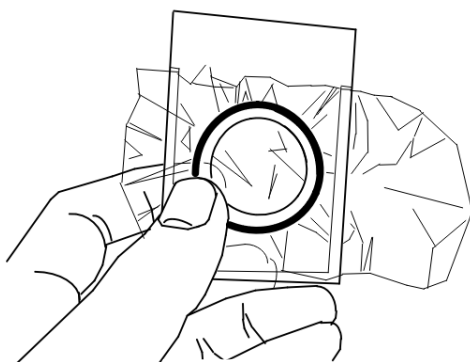


Fig. 2

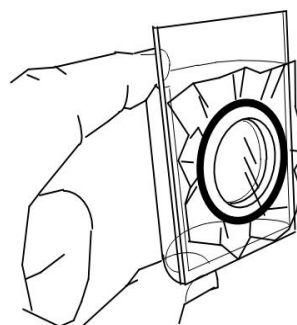


Fig. 3

3. Prepare chemicals for the experiment

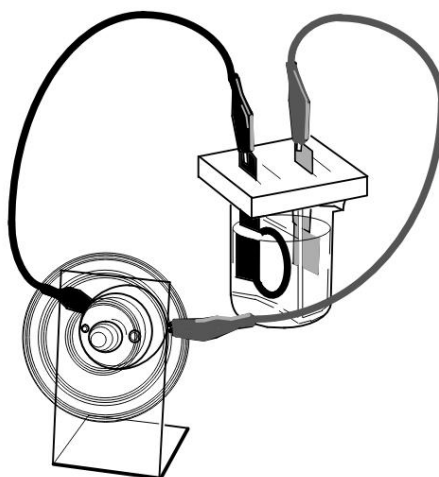
You need to prepare Zinc sulfate solution and Copper sulfate solution beforehand as it is not included in this set. Recommended concentration of Zinc sulfate solution is 7% and the recommended concentration of Copper sulfate solution is 14%. Prepare about 40 mL of each solution for one experiment.

Experiment

1. Fill the Nested Container with 40 mL of copper sulfate solution.
2. Insert the Nested Container (with Copper sulfate solution) in a 100 mL empty beaker.
3. Fill an empty space of the beaker with 40 mL of Zinc sulfate solution.
4. Insert and set a copper plate and a zinc plate to the electrode holder.
5. Put the electrode holder on the container so that the copper plate will be inserted into the Copper sulfate solution and the zinc plate into the Zinc sulfate solution.
6. Connect the lead wires with clips to each electrodes of the holder. And connect the other end of the lead wires to a propeller motor or an electric melody, DC voltmeter "Crabee" etc.

Precautions:

This product is not intended for long time experiments, because the chemical solutions will mix eventually as the semipermeable membrane film is fixed only by the rubber ring to the nested container, thus not completely sealed.



Clean up After Experiments

Disassemble the apparatus completely after the experiment and separate all the parts, especially chemicals, metal parts, semipermeable membrane film.

- Wash and clean the Nested Container and the O ring, semipermeable membrane film by water from solution and dry them afterwards.
- Wash and dry the metal parts.
- Dispose the cellophane after drying it. If you want to re-use it, it can be done, just wash and dry it thoroughly.

If you will be reusing the metal parts you can do so, please note that the surface of the metals will most likely have stains or have oxidized by chemical reaction, therefore polish the metal parts surface by sandpaper (not included) before doing experiment next time.

Storage

Please store this product and its parts away from direct sunlight, high temperature and high humidity. Especially, the semipermeable membrane film is particularly vulnerable to humidity, therefore we recommend storing it properly and use all of it soon. Chemical solutions should not be stored inside the apparatus.

Troubleshooting

When Daniell cell does not generate electricity...

* Check the condition of the surface of the metal plate inside the reactor whether the metal has stains or is oxidized. If that is the case, change the metal plate or clean it from stain or oxidation by sandpaper.

Additional Information

It is possible to change metal combination from Copper and Zinc to Copper and Aluminium, and others that are enclosed in the set.

We recommend to use the following Propeller Motor for experiments with this product:

P70-3935-W0 Propeller Motor

Voltage: 0.4 – 1.5V, Current: 16 – 20mA

Size: 50 x 50 x 90mm



For more investigation of Daniell cell or other battery types, Miniature DC Voltmeter is useful item to compare these combination of metal regarding electricity (electromotive force).

A05-7065-W0 DC Voltmeter “Crabee” CT-V

Measurement: $\pm 25.0V$

Size: 53 x 21 x 15mm (280mm with lead wire)

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