

Electrolysis with SMARTsense (Item No.: P1375169)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

- Apple iPad

Experiment Variations:

Keywords:

voltage, current, carrier transport, ions, electrode, anode, cathode, conductivity

Task and equipment

Information for teachers

This experiment should give the students a good impression of the diverse processes occurring during charge transport by means of dissolved ions.

Note

The experiment could be extended to a higher voltage range. An improvement in the conductivity would then be given by the heating up, which would then have to be additionally explained.

Safety precautions



Copper(II) sulphate pentahydrate

Hazard statements:

- H302 - Harmful if swallowed.
- H315 - Causes skin irritation.
- H319 - Causes serious eye irritation.
- H410 - Very toxic to aquatic life with long lasting effects.

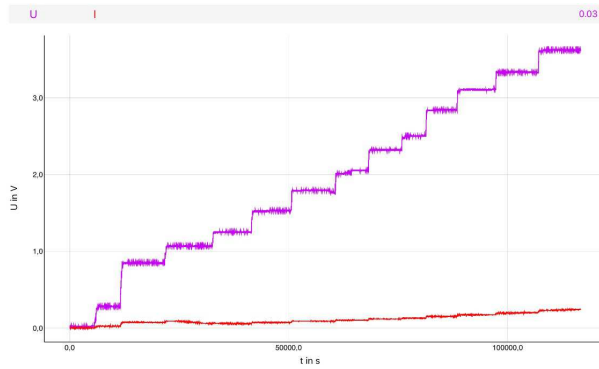
Precautionary statements:

- P273 - Avoid release to the environment.
- P302 + P352 - IF ON SKIN: Wash with plenty of soap and water.
- P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- P501 - Dispose of contents/container to an approved waste disposal plant.

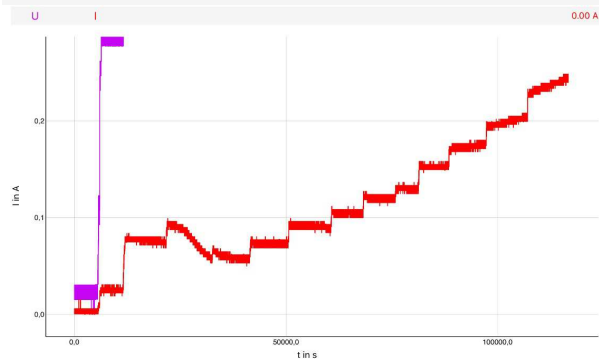
Disposal:

- Observe all federal, state, and local environmental regulations. Contact a licensed professional waste disposal service to

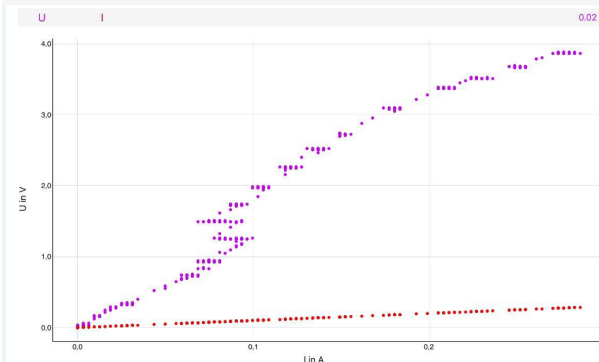
dispose of this material.



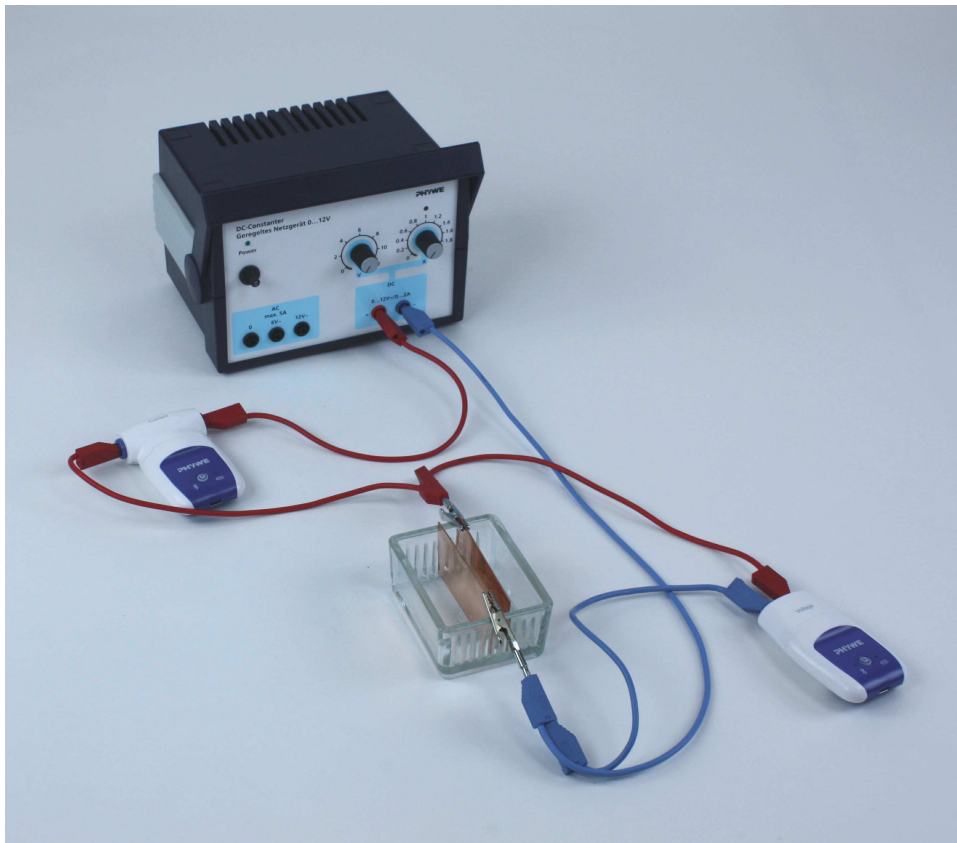
Exemplary result: Voltage against time



Exemplary result: Current against time



Exemplary result: Voltage against current.



Experiment set-up

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Task

Application

Electrolysis is one of the main processes for the production of many chemical material. One of them is aluminium, which is a very important material due to its small density but high stability.

With the help of an electrolysis process it is possible to reduce aluminiumoxide, that can be found in bauxite, which naturally occurs, to pure aluminium.



Elektrolysis is necessary for products made out of aluminium.

In this experiment we investigate how materials change during an electrolysis and which influence voltage and current do have.

Task

Do the chemical characteristics of liquids change when current flows through them?

Measure the characteristic curve of current against voltage of an electrolytic bath containing copper sulphate solution and having copper electrodes. Observe visible changes in the electrodes and the bath.

Equipment

Position No.	Material	Order No.	Quantity
1	Cobra SMARTsense - Current, ± 1 A	12902-00	1
2	Cobra SMARTsense - Voltage, ± 30 V	12644-00	1
3	PHYWE power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
4	Trough, grooved, w/o lid	34568-01	1
5	Copper electrode, 76 mm x 40 mm	45212-00	2
6	Copper-II sulphate,cryst. 250 g	30126-25	1
7	Glass rod,boro 3.3,l=200mm, d=5mm	40485-03	1
8	Alligator clips, bare, 10 pcs	07274-03	1
9	Connecting cord, 32 A, 250 mm, red	07360-01	2
10	Connecting cord, 32 A, 250 mm, blue	07360-04	1
11	Connecting cord, 32 A, 500 mm, red	07361-01	1
12	Connecting cord, 32 A, 500 mm, blue	07361-04	1

Position No.	Material	Order No.	Quantity
13	Tablet		1
14	PHYWE measure App		1

Set-up and procedure

Set-up

- Set up the experiment as shown in the photo (Fig. 1), the detailed photo (Fig. 2) and the circuit diagram (Fig. 3).
- Scrub the copper electrode to remove any coating using a washing-up sponge. Use steel or zinc wire wool in stubborn cases.
- Pour 100 ml of demineralized water in the grooved trough and dissolve in it 0.8 g of $\text{CuSO}_4 \cdot 5 \text{H}_2\text{O}$ (copper (II) sulphate pentahydrate) (about a heaped spatula tip).
- Set the voltage regulator of the power supply to 0.V and the current limitation to 1 A, then switch the power supply on.

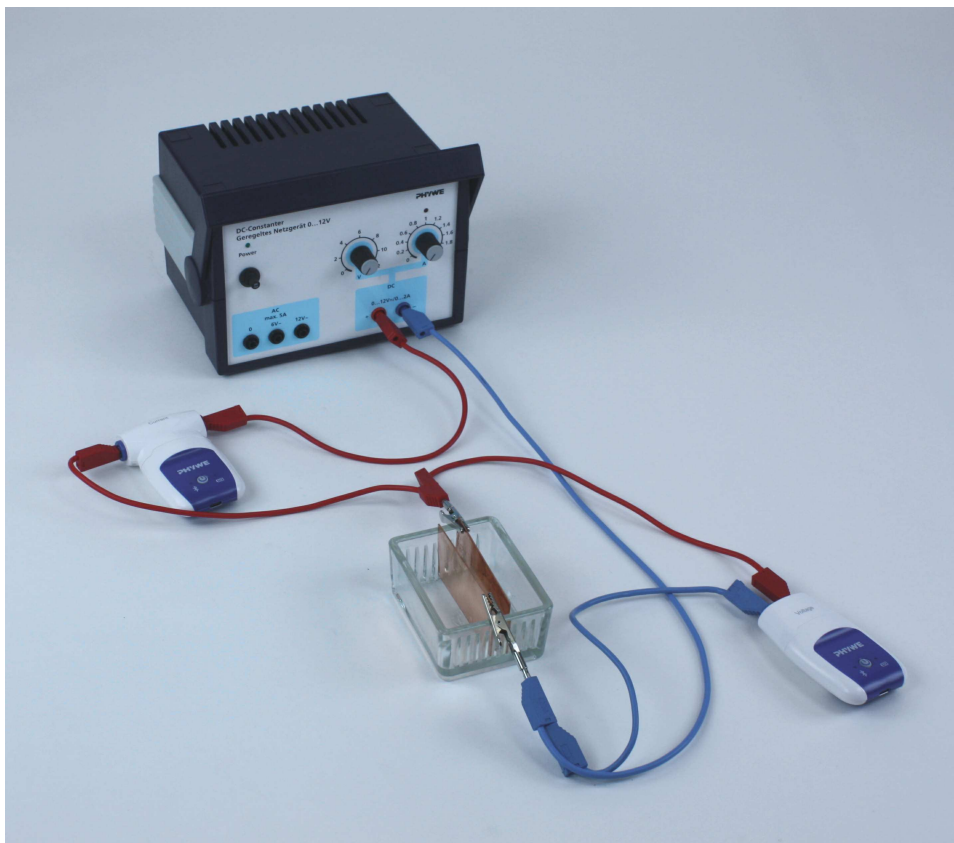


Fig. 1: Experiment set-up

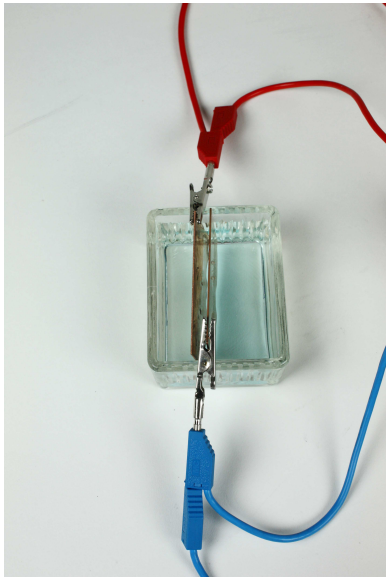


Fig. 2: The set-up of the electrolytic bath. Place the electrodes in neighbouring grooves and slope them in the same direction so that they are as parallel to each other as possible. Do not allow the two electrodes or the two alligator clips touch each other.

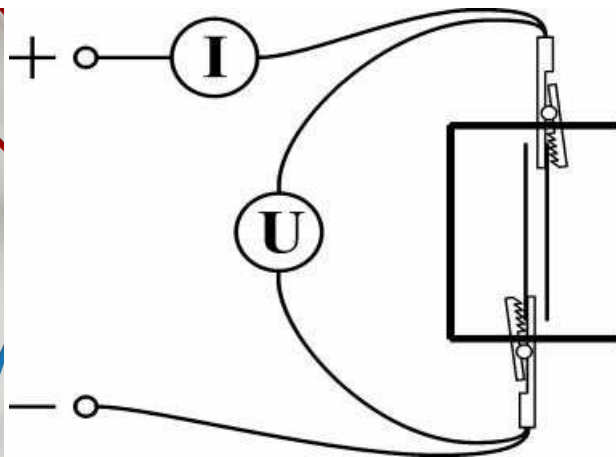


Fig. 3: Circuit diagram. Plus and minus are connected to the power supply.

Procedure


- Switch on both SMARTsense-sensors and make sure the tablet can connect with bluetooth devices.
- Open the PHYWE measure App  and select via "Measure" both sensors "Voltage" and "Current".
- Use the y-axis to display the voltage U and the current I .
- Start measured value recording in measureApp.
- Increase the voltage in steps of 0.2 to 0.3 V until you reach 3 V, wait 20 s after each step. Your live-data should look like in fig. 4.
- Observe the electrodes.
- End measurement, save and open the measured data under "measurements" for further analysis. Use the "zoom"-tool to analyse the current.
- Turn the voltage back to 0 V.
- Take the copper plates out of the solution and take a close look at them, note what you observe.
- Now use the y-axis to display the voltage U and the x-axis to display the current I . Repeat the measurement. Save afterwards. Open the data under "measurements" and analyse the graph and take notes.
- Finally properly dispose of the copper sulphate solution and clean the electrodes and the grooved trough – again scrubbing them with a sponge – then wash your hands.



Fig. 4: Measurement window

Evaluation