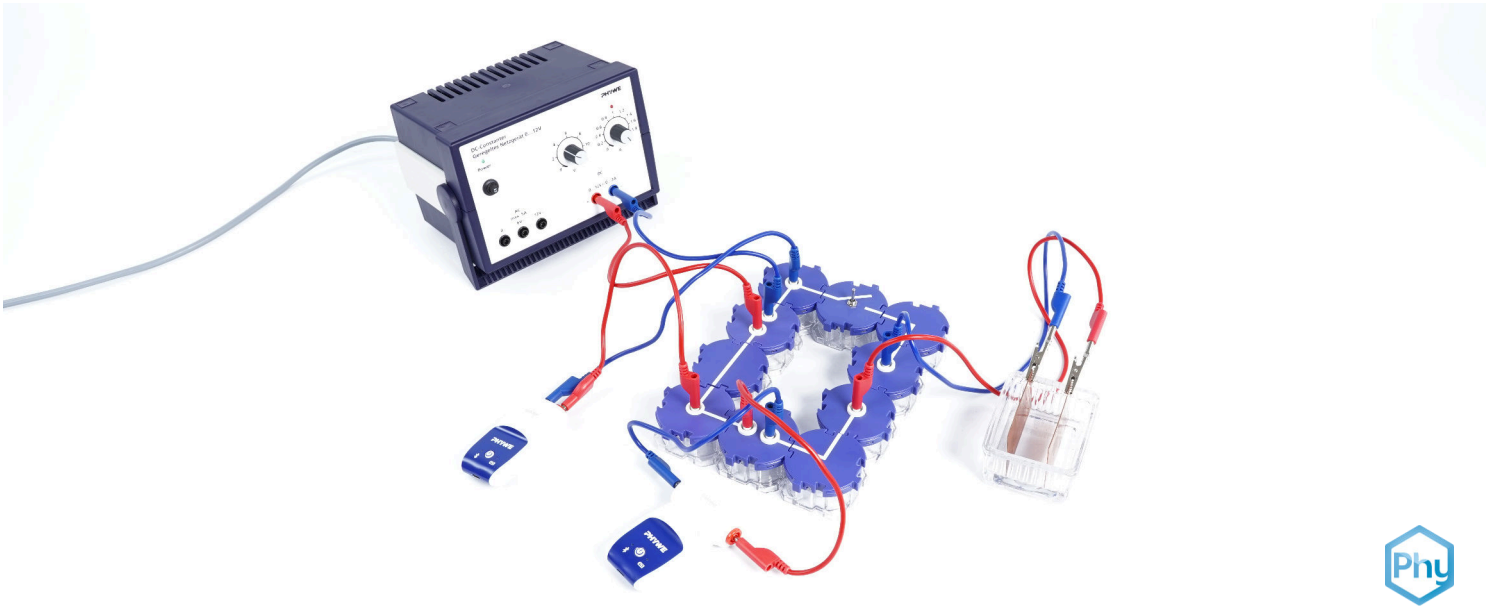
Galvanisation with Cobra SMARTsense



In a model experiment, the students are asked to apply a metallic copper coating to part of a sheet of iron.

Physics > Electricity & Magnetism > Electric current & its effects

Difficulty level	Group size	Preparation time	Execution time
medium	2	10 minutes	10 minutes

This content can also be found online at:

https://www.curriculab.de/c/6811e5a83e87bd0002fc904f

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Teacher information

Application

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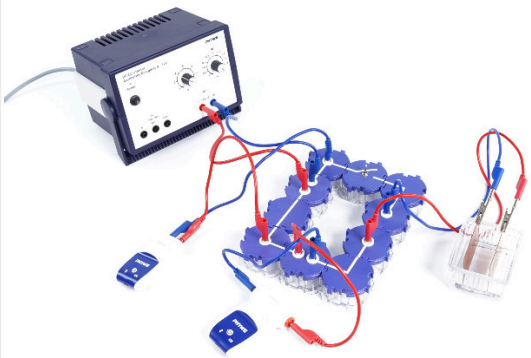

Experimental setup

For aesthetic purposes and to protect against corrosion, everyday objects are often coated with a thin layer of nickel, chrome, silver, or gold.
This is achieved through an electrochemical process known as electroplating.

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Other teacher information (1/2)

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Prior knowledge

For this experiment, the students should be familiar with the fact that aqueous solutions conduct electricity.

Principle

If a voltage is applied to two electrodes immersed in the aqueous solution of an electrolyte, the ions move in the direction of the electrode with the opposite electrical polarity. As the charge transport is realised via mass transport, this can be used to coat substances with other substances.

Other teacher information (2/2)

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Learning objective

In a model experiment, the students are asked to apply a metallic copper coating to part of a sheet of iron.

Tasks

Demonstrate in a model experiment how a sheet of iron can be coated with a layer of copper.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Safety instructions

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- Wear safety goggles and protective gloves.
- Please refer to the relevant safety data sheets for the H and P phrases.
- The general instructions for safe experimentation in science lessons apply to this experiment.

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Student information

PHYWE

Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Motivation

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For aesthetic reasons and to protect against corrosion, everyday objects are often coated with a layer of nickel, chrome, silver, or gold. This is done electrochemically, and the process is called electroplating.

Galvanised objects

Tasks

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1. Set up the experiment using the photos
2. Clean the electrodes
3. Start the galvanizing process using the instructions
4. Record your observations

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

Materials

Position	Material	Item No.	Quantity
1	Cobra SMARTsense Current - Sensor for measuring electrical current ± 1 A (Bluetooth + USB)	12902-02	1
2	Cobra SMARTsense Voltage - Sensor for measuring electrical voltage ± 30 V (Bluetooth + USB)	12901-02	1
3	Straight connector module, SB	05601-01	1
4	Angled connector module, SB	05601-02	4
5	Interrupted connector module with sockets, SB	05601-04	2
6	Junction module, SB	05601-10	2
7	On-off switch module, SB	05602-01	1
8	Trough, grooved, w/o lid	34568-01	1
9	Copper electrode, 76 mm x 40 mm	45212-00	2
10	Iron electrode, 76 x 40 mm	45216-00	2
11	Alligator clips, bare, 10 pcs	07274-03	1
12	Connecting cord, 32 A, 250 mm, red	07360-01	2
13	Connecting cord, 32 A, 250 mm, blue	07360-04	2
14	Connecting cord, 32 A, 500 mm, red	07361-01	1
15	Connecting cord, 32 A, 500 mm, blue	07361-04	1
16	PHYWE Power supply, 230 V,DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1
17	Sulphuric acid, 10%, tech.gr., 1000 ml	31828-70	1
18	Water, distilled 5 l	31246-00	1
19	Emery paper, medium	01605-00	1
20	Copper-II sulphate,cryst. 250 g	30126-25	1
21	Denaturated alcohol (spirit for burning), 1000 ml	31150-70	1
22	Spoon, with spatula end, 180 mm, plastic	38833-00	1
23	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Robert-Bosch-Breite 10
37079 Göttingen

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Fax: 0551 604 - 107

info@phywe.de
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Setup (1/4)

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To measure with the **Cobra SMARTsense sensors**, the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the respective app store (QR codes below). Please check that **Bluetooth is enabled** on your device (smartphone, tablet, desktop PC) before starting the app.

measure App for Android operating system

measureAPP for iOS operating systems

measureAPP for tablets / PCs with Windows 10

Setup (2/4)

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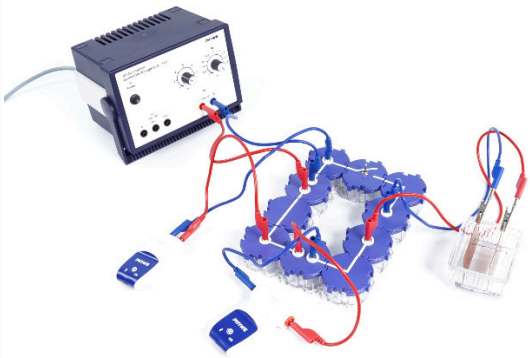

Experimental setup

- Set up the experiment as shown, initially leaving the switch open. Insert the electrodes into the grooved trough and connect them using the crocodile clips and short connecting leads so that the iron electrode is connected to the negative terminal, i.e. the cathode. Add some diluted sulphuric acid to the solution and stir gently.
- Clean the grooved trough, then carefully sand the electrodes with sandpaper. Wipe them with alcohol (e.g. spirit), and avoid touching them with your fingers afterwards to ensure the surfaces remain grease-free.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
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info@phywe.de
www.phywe.de

Setup (3/4)

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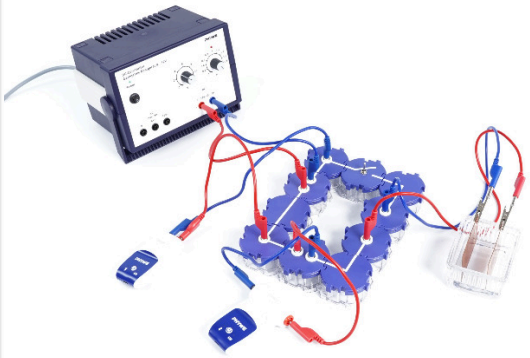
- Fill the grooved trough two-thirds full with distilled water and then add about two spoons of copper sulphate to the water while stirring until the solution is saturated.
- Set the power supply unit to $0\ \mathrm{V}$ and switch it on.



Experimental setup

Setup (4/4)

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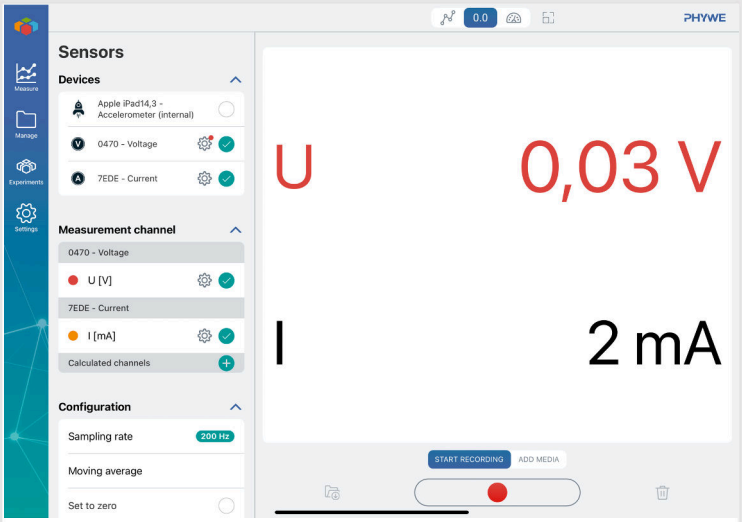

Example screenshot of the measureAPP

- Start both Cobra SMARTsense sensors by pressing and holding the on/off button on each device for about three seconds.
- Then launch the measureAPP and connect to both sensors. Configure the display so that the measured values appear as numbers. To do this, tap on "0.0" at the top of the app. A visual example is shown on the left-hand side.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
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info@phywe.de
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Procedure (1/2)

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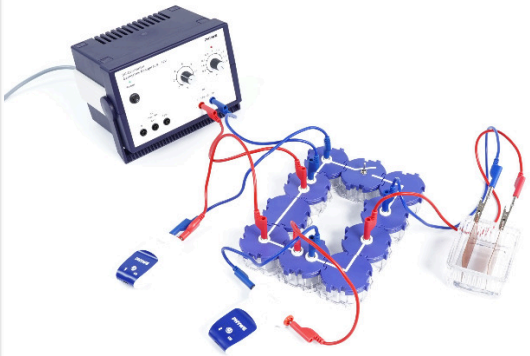
- Close the switch and increase the voltage at the power supply unit until a current of approx. $150\ \mathrm{mA}$ is reached.



Procedure (2/2)

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- Observe the processes at the electrodes and record your observations in the lab log.
- After approximately 3 minutes, open the switch, set the power supply unit to $0\ \mathrm{V}$, and switch it off.
- Rinse the iron electrode with water, examine the part that was immersed, and note your observations in the lab log.
- Dry the copper electrode, dispose of the aqueous solution properly, clean the grooved trough, and wash your hands thoroughly with soap.

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de

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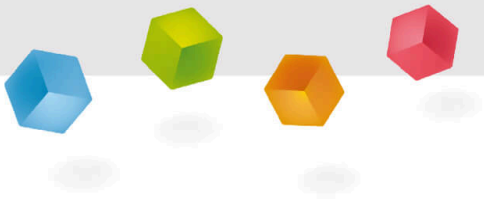

Report

Observation (1/2)

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Note down your observations on the processes during the current flow:

a) at the anode:

b) at the cathode:

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
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Observation (2/2)

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Note down your observations on the condition of the iron electrode after the experiment:

Task (1/2)

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Drag the words into the correct boxes!

If contacts are in a conductive liquid, electricity flows. Liquids, e.g. acids, alkalis or water with dissolved salts, conduct electricity. These substances are also called _____. If a _____ is applied, the positive cations move to the _____ and the negative anions to the _____. _____ takes place at the anode. Cations that get close enough to the cathode pick up _____ from the cathode. They are therefore _____ and accumulate as metal on the cathode.

anode
Oxidation
reduced
electrolytes
electrons
cathode
voltage

Check

PHYWE
Robert-Bosch-Breite 10
37079 Göttingen
Tel.: 0551 604 - 0
Fax: 0551 604 - 107
info@phywe.de
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Task (2/2)

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The process in which an electric current through a salt solution is used to coat the surfaces of conductive materials with a layer of metal is called electroplating. Give examples of electroplated objects.

Slide	Score / Total
Slide 19: Principle	0/7

Total score 0/7

Show solutions | Repeat | Export text

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Robert-Bosch-Breite 10
37079 Göttingen

Tel.: 0551 604 - 0
Fax: 0551 604 - 107

info@phywe.de
www.phywe.de