Galvanization (Item No.: P1397200)

Curricular Relevance

Area of Expertise: Physics
Education Level: Age 14-16
Topic: Electricity
Subtopic: Current and its effect
Experiment: Galvanization

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	10 Minutes	2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Principle and equipment

Principle

An experimental model is to be used to demonstrate how surfaces of non noble metal objects can be coated with noble metals by galvanization.

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.

Denaturated alcohol
Hazard statements:

- H225 - Highly flammable liquid and vapour.
- H319 - Causes serious eye irritation.

Precautionary statements:

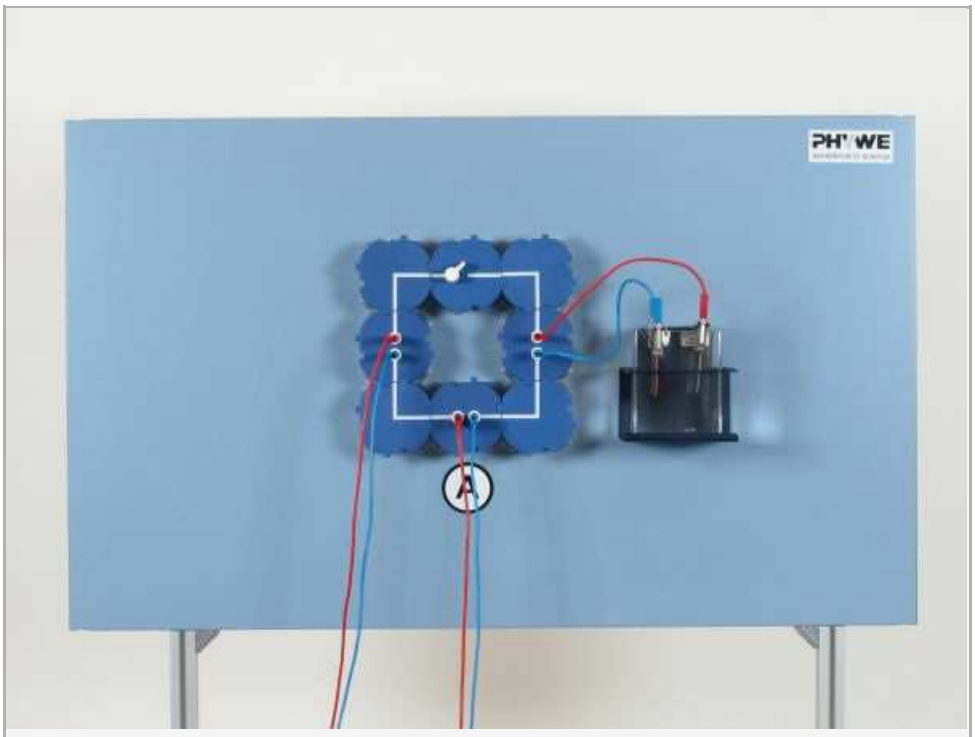
- P210 - Keep away from heat, hot surfaces, sparks, open flames and otherignition sources. No smoking.
- P280 - Wear protective gloves/protective clothing/eye protection/face protection.
- P243 - Take precautionary measures against static discharge.
- P305 + P351 + P338 - IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and

easy to do. Continue rinsing.

- P337 + P313 - If eye irritation persists: Get medical advice/attention.
- P403 + P235 - Store in a cool and well-ventilated place.
- P501 - Dispose of contents/container to an approved waste disposal plant.

Disposal:

- We recommend that you contact either the authorities in charge or approved waste disposal companies which will advise you on how to dispose of special waste.



Experimental set-up

Equipment

Position No.	Material	Order No.	Quantity
1	Multimeter ADM2, demo., analogue	13820-01	1
2	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13500-93	1
3	Demo Physics board with stand	02150-00	1
4	Switch on/off, module DB	09402-01	1
5	Connector interrupted, module DB	09401-04	3
6	Support plate w. holder,module DB	09471-00	1
7	Glass tank, 100x50x120 mm	06620-10	1
8	Electr.symbols f.demo-board,12pcs	02154-03	1
9	Connector, angled, module DB	09401-02	4
10	Plate electrode holder	06618-00	2
11	Copper-II sulphate,cryst. 250 g	30126-25	1
12	Denaturated alcohol (spirit for burning), 1000 ml	31150-70	1
13	Sulphuric acid, 10%, tech.gr., 1000 ml	31828-70	1
14	Emery paper, medium, 5 sheets	01605-02	1
15	Connecting cord, 32 A, 1000 mm, red	07363-01	2
16	Connecting cord, 32 A, 1000 mm, blue	07363-04	2
17	Connecting cord, 32 A, 250 mm, red	07360-01	1
18	Connecting cord, 32 A, 250 mm, blue	07360-04	1
19	Copper electrode, 76 mm x 40 mm	45212-00	1
20	Iron electrode, 76 x 40 mm	45216-00	1
21	Spoon,w.spatula end,18 cm,plastic	38833-00	1
Additional material:			
	Distilled water		
	Absorbent cloth or paper		

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Set-up and procedure

Preparation for the experiment:
Clean the trough; clean the electrodes by thoroughly rubbing them down with sandpaper, wipe the iron electrode with alcohol and thereafter avoid touching it with bare hands (so that its surface remains fat-free)

- Roughly half fill the trough with distilled water; add 1 spoonful of copper sulphate and stir; acidity the solution with a few ml of sulphuric acid
- Set up the experiment as shown in Fig.1; fix the throroughly cleaned (sandpapered) electrodes to the holders and dip them into the solution
- Connect the electrodes to the source of current, the copper one to the positive pole and the iron one to the negative pole, and set the 300 mA- measurement range
- Close the switch, switch on the power supply and increase the voltage from 0 V until a current intensity of 1 00 ... 200 mA is reached; observe the processes that take place at the electrodes
- As soon as the cathode (the iron electrode) has a distinct reddish-brown colour, switch off the power supply
- Remove the iron electrode, rinse it with water and allow it to dry

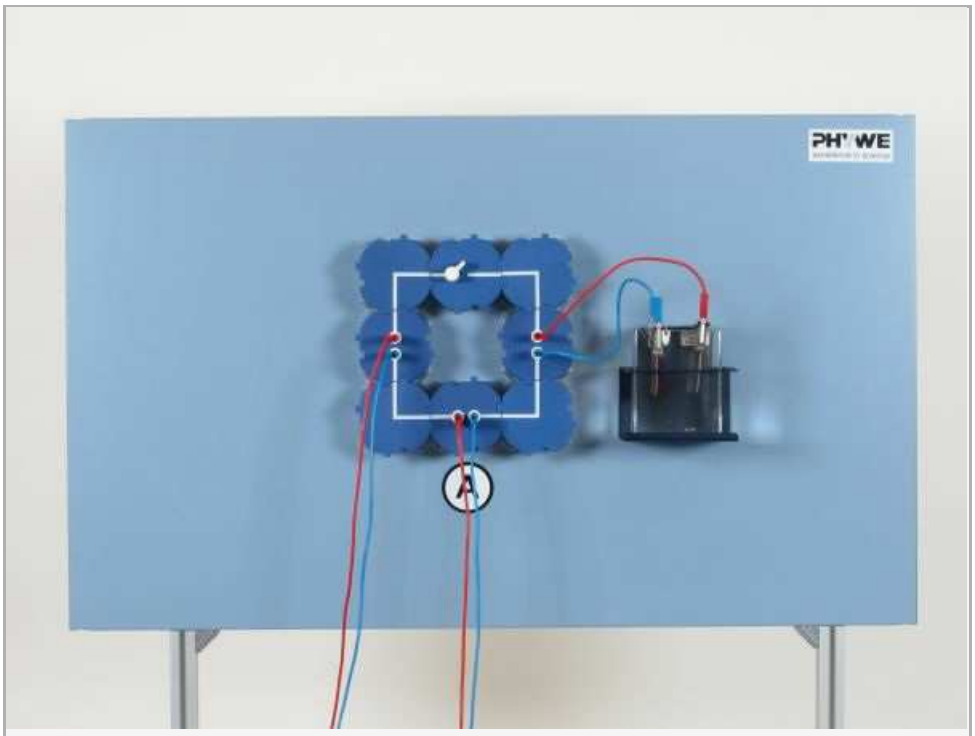

Fig. 1

Observation and evaluation

Observation

At the anode, the surface of the area that is immered in the solution and faces the cathode is darkened. At the cathode, the immersed part of the iron electrode becomes reddish-brown in colour, and small gas bubbles are formed, which finally rise up. At the end of the experiment, the immersed part of the iron electrode has become covered by a layer of copper, which is very even on the surface that faced the anode.

Evaluation

The surfaces of objects made of a conducting material can be electrochemically coated with a metallic layer, and so be improved, e.g. copper-plated, nickel-plated, chromed, silver-plated, gold-plated.

An electric current is passed through a salt solution. The metal ions migrate to the cathode and are as a rule deposited there. This process is called galvanization. In this experiment, the following concrete processes take place:

Copper sulphate dissociates in water:

$CuSO_4 \longrightarrow Cu^{2+} + SO_4^{2-}$.

When the circuit is closed, the Cu2+ ions migrate to the cathode, accept 2 electrons and deposit on the surface of the cathode:

$Cu2+ + 2e\text{-} \longrightarrow Cu$.

Remarks

The copper layer that is formed in this experiment is not fast to wiping. This must be considered when drying the cathode metal sheet.

Do not wipe it dry: It is best to dry it over a non-sooty flame before passing it on for inspection. The gas bubbles that are evolved in this experiment result from the fact that electrolysis of water occurs alongside the galvanizing process.

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