Special section: microscale science - Sección especial: ciencia en microescala

Testing experiments on water in a middle school

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Abstract

Experiments published in the previous edition of this journal (NAJDOVSKI, SCHWARZ, 2008) were tested, supplemented and simplified with students of a preparatory school:

1. Electrolysis of a Petunia extract. 2. Molecule modelling with beads and chewing gum.

3. Electrolysis of water in a pipette head. 4. Ignition of a oxygen/hydrogen gas in the pipette head.

Key words: *drop electrolysis, pipette electrolysis, oxygen/hydrogen mixture, volume reduction.*

SAFETY PRECAUTIONS

Wear goggles. Work in a tray. During the ignition firmly press the neck of the pipette eudiometer dipped onto the bottom of the ampoule full of the solution. Only use sterile injection needles after cutting off their tips.

INTRODUCTION

Experiments published in the previous edition of this journal (NAJDOVSKI, SCHWARZ, 2008) were tested with students of a preparatory school, supplemented and simplified.

In their third year of learning chemistry the student´s knowledge was very poor and their motivation close to zero. One reason for that might be that students never had a chance to do experiments on themselves. In this situation learning by doing seemed to be a chance for changing. So 15 students were allowed to do experiments in groups or alone. In **experiment 1** (Figure 1) they did a simple drop electrolysis of an extract from blue petunia petals (or red cabbage) on a white plastic surface. Sterile blunted injection needles were used as electrodes and a 9-Volt battery as power supply. Describing their observations was a first step of the teacher to get talking to the students. Words like hydrogen, oxygen, indicator, acid, base, neutralisation, atoms, molecules, electrons, indicators were mentioned. In order to teach again about these terms and reactions **experiment 2** (Figure 2) with white and red beads as models of hydrogen and oxygen atoms were done. Small balls of UHU Pattafix (or chewing gum) were models of electron pairs ("glew between atoms"). By halfing them single electrons were visualized.

Models of oxygen, hydrogen and water molecules and of hydroxide-ions and "H^+ ions" could be formed.

In **experiment 3** (Figure 3 and http://www.youtube.com/v/JUvuyshjeKk&rel=1) the electrolysis of water was repeated in a pipette head like published in the previous edition of this journal (Najdovski, Schwarz 2008).

In **experiment 4** (Figure 4) the eudiometer was very much simplified and improved by doing the explosion directly in the pipette head.

1. Drop electrolysis with an extract from blue Petunia petals

Blue extracts from Petunia flowers (or a red cabbage leave) are acid/base indicators. Colour changinge to red indicates an acid, colour change to green indicates a base.

Experiment

a) Turn a white film canister upside down.

b) Transfer a big drop of blue petunia or cabbage extract onto it.

c) Use scissors to blunt two sterile hypodermic needles.

d) Connect them with a 9-V-battery.

e) Dip them onto the drop.

Observations

See Figure 1.

Figure 1. Drop electrolysis of a blue plant extract (left side is green, right side is red. After stirring it will be blue again).

2. Visualize the smallest particles of water and how they change in the electrolysis

Up: Formation of an acid ("H^+") ion and a base ion ("OH").
Down: Formation of atoms.

Experiment

a) Take 8 white beads (models of hydrogen atoms) and 4 red beads (models of ogygen atoms) and 8 small balls of UHU patafix or chewing gum (models of bonding electron pairs) onto your tray.

b) Connect 8 white and 4 red balls to make models of 4 water molecules.

c) Split one of these water molecule models to make models of H and of O atoms (What must be done with the 4 "electron pair models"?).

d) Demonstrate what happens with the two hydrogen atom models.

e) Split the second water molecule model to make an "acid ion" (H^+) and a "base ion" (OH^-).

f) Take the following equations and your models to visualize what happens with them during the electrolysis:
Negative electrode: water (H_2O) → hydrogen (H_2) + base (OH^-)
Positive electrode: water (H_2O) → oxygen (O_2) + acid (H^+)

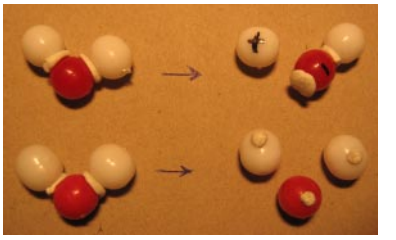

Figure 2. Two models of splitting water molecules in experiment 1

3. Electrolysis of water in a pipette head: Production of a hydrogen/oxygen mixture

The students repeated the experiment like published in the previous edition of this journal (Najdovski, Schwarz 2008) succefully simplifying it by replacing the closed injection needles by pins (Figure 3).

The electric conductivity is increased by adding Glauber salt. Figure 3 shows the end of the electrolysis with the pipette head nearly full of the gas mixture built at the needles.

Videoclip: http://www.youtube.com/v/JUvuyshjeKk&rel=1

4. Ignition of the oxygen/hydrogen mixture in the pipette head

The eudiometer described in the previous experiment was very much simplified and improved:

a) Replacing the syringe eudiometer by the pipette used for the electrolysis (Figure 3).

b) Collecting the solution pressed out of the pipette head by the gas mixture in a high 5 mL-ampoule.

c) Adding as much water as possible.

d) Piercing the pipette head full of gas mixture by two more pins.

e) Connecting them with the piezo igniter.

Figure 3. Electrolysis of water in a pipette head. (Most of the water is replaced by the mixture of its elements)

During the ignition firmly press the neck of the pipette eudiometer dipped onto the bottom of the ampoule full of the solution.

Observation and explanation:

Pressing the button of the piezo igniter results in a flash and a small implosion. The mixture of oxygen and hydrogen gas disappears by the chemical reaction that produces a negligable small volume of liquid water. So the pipette head is compressed by the air from outside. The elasticity of the pipette head sucks the liquid back to the ampoule head.

The experiment can be seen in two videoclips: http://de.youtube.com/watch?v=AiT7l7TLirM and http://www.youtube.com/v/MIkAEcNpqyg).

BIBLIOGRAPHY

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