Decomposing Water into Hydrogen and Oxygen Through Electrolysis of Water

Student's Name

Course

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Date

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Introduction

Electrolysis occurs when a direct electric current is applied to elements to cause an otherwise non-spontaneous reaction. (Levie, 1999) In this experiment, electrolysis will catalyze a chemical reaction known as electrochemical water splitting.

As a result of the direct current application, water should decompose into hydrogen and oxygen. This will be the hypothesis tested by this experiment.

Materials

- Lab manual
- Pure water (500 ml)
- A glass container for the water
- 9-volt battery
- Two alligator clips
- Two pencils (#2)
- A piece of cardboard, 10 x 10 cm

Procedure

Fill the glass container with pure water. Remove the metal parts and erasers from the pencils. This will allow using the graphite in the pencils as the electrical conductors. Ergo, pencils become electrodes.

Punch holes in the cardboard and fit the pencils into them. Put the cardboard on top of the container. Pencils don't touch the bottom of the container. Attach alligator clips to each pencil. The current is now supplied by water.

Results

As soon as the direct current is supplied to water, bubbles start forming at each pencil's tip. The following chemical reaction occurs: $2\ H_2O(l) \rightarrow 2\ H_2(g) + O_2(g)$.

At the negatively charged pencil tip, there appear to be more bubbles. This is due to the hydrogen reduction reaction occurring there ($2H^+(aq) + 2e^- \rightarrow H_2(g)$) – and since water carries two hydrogen atoms and only one of oxygen. At the positively charged pencil tip, oxidation takes place: $2\ H_2O(l) \rightarrow O_2(g) + 4\ H^+(aq) + 4e^-$.

Conclusion

The application of direct current to water results in its electrolysis. Water breaks down into two elements, hydrogen, and oxygen, at the cathode and anode. Further research may investigate the impact of additional elements in the water on the electrolysis (for example, how tap or salted water behaves after the introduction of electrical current).

References

Levie, R. de (1999). “The electrolysis of water.” Journal of Electroanalytical Chemistry. 476 (1): 92–93.

Smith, J. (2020). Electrolysis of Water: Lab Manual. Cambridge University Press.