The electrolysis of acidified water using a Hofmann voltameter

Transcript

This car is powered by a hydrogen–oxygen fuel cell. The fuel cell generates electricity from an electrochemical reaction between hydrogen and oxygen with water as the only substance produced. However, a large hydrogen supply is required for these cars. One method of producing the hydrogen required is from the electrolysis of water.

In this experiment, you will use a Hofmann Voltameter to electrolyse water and determine the stochiometric ratio of hydrogen to oxygen produced.

First, the voltameter is filled with acidified water through the central reservoir at the top of the apparatus. The black cable is then connected to the negative terminal of the DC power supply and to one of the platinum electrodes. This becomes the cathode.

The red cable is connected to the positive terminal of the power supply, and to the other platinum electrode. This is the anode.

The DC power supply is then set to 12 volts and the power is switched on. Immediately, bubbles of gas are observed at both electrodes.

The production of hydrogen gas at the anode is faster than the production of oxygen gas at the cathode. After a few minutes the volume of hydrogen produced is twice that of oxygen. Therefore, the stochiometric ratio of hydrogen gas to oxygen gas is two to one.

Next, the identities of the gases can be confirmed using the qualitative tests for hydrogen and oxygen. First, place an inverted test-tube over the tap at the cathode. The tap is opened carefully to capture the hydrogen gas. When a lighted splint is placed under the test-tube, a characteristic squeaky pop is heard. This confirms that the gas is hydrogen.

Now the second tap is opened carefully to capture the oxygen gas. A glowing splint is lowered into the test-tube which re-ignites. This confirms that the gas is oxygen.

This is the half-equation occurring at the cathode.

And this happens at the anode.

Here are the two half-reactions again.

Electrons must be conserved. Therefore, after multiplying the coefficients of the reaction occurring at the cathode by two, the electrons can be cancelled out in both half-equations.

The overall equation can then be simplified.

The overall chemical equation clearly shows the stochiometric relationship between the two gaseous products. Electricity can be used to decompose acidified water into its elements easily.

The electrolysis of water is a promising option for hydrogen production for cars powered by hydrogen–oxygen fuel cells from renewable sources.