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Lab #:

Date: **Skills:** AI /10

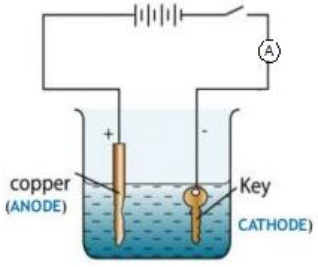
Topic: Electrolysis

Title: Copperplating a key

Aim: To use the process of electrolysis to plate a key with copper

Apparatus and Materials: power source, silver key, 2 clamps and stands, copper sulphate solution, connecting wires, beaker, copper wire

Method: 1. The circuit was connected as shown.



2.The power source was switched on and allowed to run for 20 minutes.
3.Observations were made during and after the electrolytic process.

Observations:
The colour of the electrolyte remains the same
The anode gains some grooves and ridges, since it decreases in size
The key changes colour to a more copper-tinged tone

Discussion:

1. Write the chemical symbols for the ions present in the solution.
   Cu^{2+}, SO_4^{2+} from copper sulfate; H^+, OH^- from water

2. Explain **<u>fully</u>**, the changes occurring at the cathode, anode and in the electrolyte. Your answer should include half equations, type of reaction at each electrode, colour changes and changes in mass.
   At the cathode, reduction occurs, which is the gain of electrons. Copper is discharged, because it is lower in the electrochemical series than H^+.
   $Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$

The solid copper metal forms on the key and coats it, giving it a copper colour. Th emass of the cathode increases with the addition of solid copper.
At the anode, oxidation occurs, which is the loss of electrons. The copper solid turns into copper ions, which join the solution, giving it its blue colour. The anode decreases in size, which is the same amount by which the anode increases. The colour of the anode remains the same.

$Cu_{(s)} \rightarrow Cu^{2+}_{(aq)} + 2e^-$

At the electrolyte, the Cu^{2+} ions and the SO_4^{2-} ions are roaming free. The colour of the electrolyte remains the same because every copper ion that is deposited at the cathode is replaced by one at the anode, so there is no net loss. Essentially, the ions are transferred from the anode to the cathode. There is the same amount of copper ions that it started with, so the concentration remains the same, as does the colour.

3. Calculate the mass of copper that is expected to be deposited on the key after 20 minutes. (Assume that a current of 4A flows).

$t = 20 \times 60$

$t = 1200\,s$

$Q = It$

$Q = 4A \times 1200\,s$

$Q = 4800\,C$

$\#mol\,e^- = \frac{Q}{F}$

$\#mol\,e^- = \frac{4800\,C}{96500\,C/mol}$

$\#mol\,e^- = 0.04975$

$Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$

molratio e : Cu

2 : 1

0.04975 : x

$2x = 0.04975$

$x = 0.024875\,mol\,Cu_{(s)}$

$= 0.02\,mol\,Cu_{(s)}$

$mass = 63.546\,g/mol \times 0.02\,mol$

$mass = 1.27\,g\,Cu_{(s)}$

Conclusion:

In conclusion, electrolysis was used to copperplate a key successfully. The anode lost electrons, and the cathode gained electrons. The mass of the cathode increased by 1.27 grams, and the mas of the anode decreased by the same amount, while the electrolyte remained the same.