

Determination of decomposition voltage in electrolysis

1.INTRODUCTION

Decomposition potential (decomposition voltage), in electrochemistry, refers to the minimum voltage (difference in electrode potential) between anode and cathode of an electrolytic cell that is needed for electrolysis to occur.

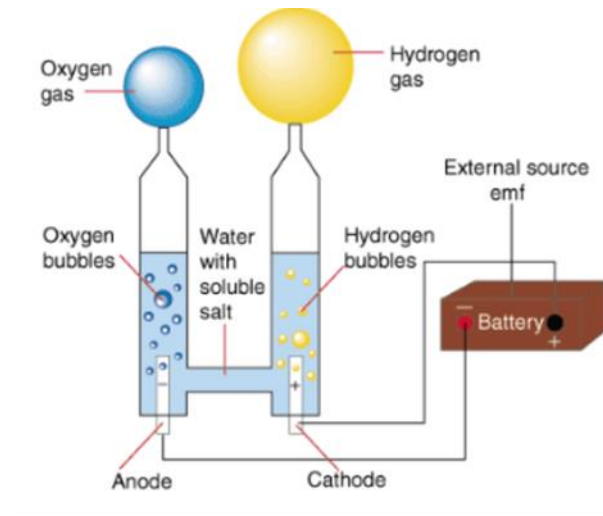


Fig.1.

The voltage at which electrolysis is thermodynamically preferred is the difference of the electrode potentials as calculated using the Nernst equation. Often the actual voltage needed for electrolysis is greater than the thermodynamical value. The additional voltage is referred to as overpotential and is especially high in electrolysis reactions that involve gases, such as oxygen, hydrogen or chlorine. Increasing voltage above the decomposition potential can increase the rate of reaction.

Electrolysis of water is the decomposition of water into oxygen and hydrogen gas due to the passage of an electric current. The reaction has a standard potential of -1.23 V , meaning it ideally requires a potential difference of 1.23 volts to split water. The thermodynamic requirement is 1.23 V. This is what it takes to break the bonds. However, in practice you need more than this for two reasons:

Overvoltage. This is extra voltage required to get the gases off the electrodes and depends on the electrode material and how much the bubble stick to the surface.

Non-equilibrium conditions. If you want to actually produce gas at a reasonable rate you will need a higher voltage.

Both the SEM cells and the decomposition voltage are measurable quantities. We know that the $I=f(U)$ function has a linear character for the type I (metal) conductors according to the Ohm's law, but for conductors of the second type (electrolyte solutions) slightly different.

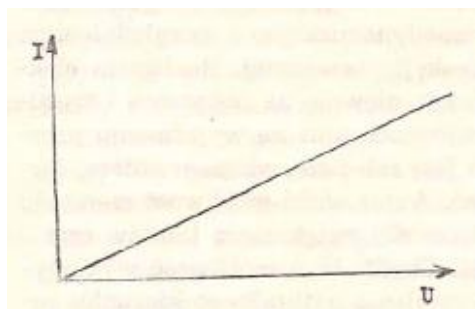


Fig.1.The graph of the function $I=f(U)$ for the I type of conductors

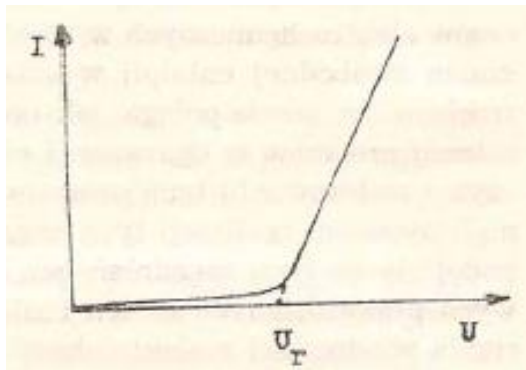


Fig.2. The graph of the function $I=f(U)$ for the II type of conductors

It is enough to extend the linear section of the growing segment of the curve $I = f(U)$ to obtain the U_r value.

2. The course of the experiment

Conduct the electrolysis of the chosen solution on the Hoffman apparatus.

It is necessary to prepare a current-voltage curve.

Turn potentiometer knob to the right of the cell by not more than 0.2V (read on a voltmeter), after each voltage change wait 0.5 minutes. After that time read the current from multimeter. The results of the measurements should be presented in the table (Tab.1.)

Tab.1. Measurements of decomposition voltage

No.	5%NaOH	
	U(V)	I(mA)

3. Preparation of results

The voltage to be applied to the electrodes of the electrolyzer to force the flow of current I is equal to:

$$U = U_r + IR + \eta$$

U_r - decomposition voltage

R - resistance of electrolyte

η -sum of cathode and anode voltage

The results obtained from the measurements should be presented in the form of the function $I = f(U)$. Then read the U_r value from the graph.

The report should contain:

1. The purpose of the exercise
2. Handwritten position diagram
3. Example calculations
4. Conclusions

One report per "small" group.