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Electrolytic Cell: How it works

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Abstract

An electrolytic cell is an electrochemical cell that drives a non-spontaneous redox reaction with electrical energy. Electrolysis—the Greek term lysis means "to break up"—is frequently employed to breakdown chemical substances. Electrolysis is used to break down water into hydrogen and oxygen, as well as bauxite into aluminium and other compounds. An electrolytic cell is used to electroplate (for example, copper, silver, nickel, or chromium). Electrolysis is a process that employs the utilisation of a direct electric current (DC). There are three pieces to an electrolytic cell: an electrolyte and two electrodes (a cathode and an anode). The electrolyte is typically a dissolved ion solution in water or other solvents. Electrolytes include molten salts like sodium chloride. The ions in the electrolyte are attracted to an electrode with the opposite charge when an external voltage is supplied to the electrodes, allowing charge-transferring (also known as faradaic or redox) events to occur. An electrolytic cell can only breakdown a typically stable or inert chemical substance in solution with an external electrical potential (i.e., voltage) of the proper polarity and adequate magnitude. The electrical energy can cause a chemical reaction that would not happen naturally otherwise.

Keywords: ***Nanoparticle; Photoelectrochemistry; Electrocatalysis***

Introduction

An external voltage drives a current through an electrolytic cell, causing a chemical reaction that would otherwise be nonspontaneous to occur. The development of a spontaneous chemical reaction causes an electric current to flow in a galvanic cell. An electrochemical cell in equilibrium is halfway between an electrolytic and a galvanic cell. The propensity of a spontaneous reaction to push current through an external circuit is perfectly balanced by an external voltage known as a counter electromotive force or counter e.m.f., resulting in no current flowing. The cell becomes an electrolytic cell when the counter voltage is increased, and a galvanic cell when it is dropped. The cathode of a cell is the electrode to which cations (positively charged ions, such as silver ions Ag+) travel within the cell to be reduced by interacting with electrons (negatively charged) from that electrode, according to Michael Faraday. He also described the anode as the electrode to which anions (negatively charged ions such as chloride ions Cl) travel within the cell to be oxidised by depositing electrons.

Consider the case of two voltaic cells with different voltages. Each one's positive and negative electrodes should be labelled with the letters P and N, accordingly. Place them in a circuit with P close to P and N close to N, so the cells will push current in opposing directions. The cell with the higher voltage is discharged, resulting in a galvanic cell, with P serving as the cathode and N serving as the anode, as explained above. The cell with the lower voltage, on the other hand, is an electrolytic cell. Negative ions are pushed towards P in the electrolytic cell, whereas positive ions are pushed towards N. While the electrolytic cell is being charged, the P electrode of the electrolytic cell fulfils the definition of anode. Electrolytic cells are used in the commercial electrorefining and electrowinning of a variety of non-ferrous metals. Electrolytic cells are used to manufacture almost all high-purity aluminium, copper, zinc, and lead used in industry. Water may be electrolyzed, as previously stated, especially when ions are introduced (salt water or acidic water) (subjected to electrolysis). H+ ions move to the cathode when a voltage source is applied, where they mix with electrons to form hydrogen gas in a reduction process. In an oxidation process, OH ions move to the anode to release electrons and an H+ ion to form oxygen gas.

When current is conducted through molten sodium chloride, the anode oxidises chloride ions (Cl) to chlorine gas, releasing

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electrons to the anode. The cathode also lowers sodium ions (Na^+), which take electrons from the cathode and deposit as sodium metal on the cathode. It is also possible to electrolyze NaCl dissolved in water. The anode produces Cl_2 gas by oxidising chloride ions (Cl). Water molecules are converted to hydroxide ions (OH) and hydrogen gas at the cathode, rather than sodium ions being reduced to sodium metal (H_2). The electrolysis produces chlorine gas, hydrogen, and aqueous sodium hydroxide (NaOH) solution as a byproduct of the process.