ALCHEMY

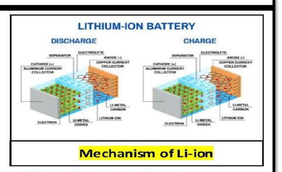
e – Issue : October 2021

Department of Chemistry, Dum Dum Motijheel College, Kolkata – 700 074

LITHIUM ION BATTERY

Mrinal Roy, BSc chemistry (Honours),Dum Dum Motijheel College

INTRODUCTION : Lithium ion battery is a type of rechargeable battery and these are commonly used for portable electronic and electric vehicles. The technology was developed by John Goodenough, Stanley Whittingham and Akira Yashino.



Mechanism of Li-ion

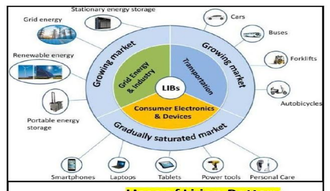
MECHANISM: In these batteries, During charging Lithium ions move from negative electrode (generally made of Graphite) to positive electrode (which is made of metal oxides) through an electrolyte (which is made of Lithium salt in an organic solvent) and vice versa for discharging.


John B. Goodenough M. Stanley Whittingham Akira Yoshino

WHY IT'S DISCOVERY WAS NEEDED AND HOW IT'S IMPROVED: The foundation of the Lithium ion battery was laid during the oil crisis in 1970s. Dr. Whittingham worked on developing methods that could lead to fossil fuel free energy technologies in 1970s and after that in 1979s Dr. Goodenough doubled the potential of these batteries and created the right condition for a vastly more powerful and useful battery. Finally in 1985 Dr. Yashino succeeded in eliminating pure lithium from the battery instead of passing it wholly on lithium ions, which are safer than pure Lithium, As a result they got Noble prize in 2019 in chemistry.

REASON FOR CHOOSING LITHIUM AMONG ALL THE ELEMENT OF PERIODIC TABLE : There are mainly two reasons for choosing Li ,FIRST , according to electrochemical series Li has a higher potential value i.e. it has higher tendency to lose electron, making it easy to get current flowing in the battery SECOND : lithium is much lighter than any other metals used in batteries which is important for small objects such as mobile, tablet, laptop etc.

USES OF LITHIUM ION BATTERY : Li-ion batteries provide lightweight, high energy density power sources for a variety of devices. To power larger devices, such as electric cars, connecting many small batteries in a parallel circuit is more effective and more efficient than connecting a single large battery. Such devices include:-



Uses of Li-ion Battery

a) Portable devices: these include mobile phones and smart phones, laptops and tablets, digital cameras ,torches etc.

b)Electric vehicles: electric vehicle batteries are used in electric cars, electric motorcycles and scooters, electric bicycles, personal transporters and advanced electric wheelchairs.

c)Power tools: Li-ion batteries are used in tools such as cordless drills, sanders, saws etc.

Environmental impact:Since Li-ion batteries contain less toxic metals than other types of batteries which may contain lead or cadmium, they are generally categorized as non-hazardous waste. Li-ion battery elements including iron, copper, nickel and cobalt are considered safe for incinerators and landfills. These metals can be recycled, usually by burning away the other materials, but mining generally remains cheaper than recycling.

Why India should used Li-ion battery : First of all, If we use batteries instead of oil in vehicles India will be self reliant and economically we can save a huge amount of foreign currency (because India needs to rely on foreign countries for the oil, used in vehicles), which can be used for the advancement of educational purposes and most importantly to avoid pollution and make a fossil fuel free society .

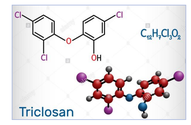
Antiperspirant & Deodorant: Some points to note

Subhojyoti Chakraborty: Sem-V-Core

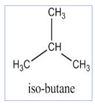
Brand 1:*Ingredients* **:**Butane, Isobutane, Propane, Cyclopentasiloxane, Fragrance, Isopropyl Myristate, Triclosan, BHT.
Brand 2: ***Ingredients*** **:**Propellant, Ethyl Alcohol, Fragrance, Propylene Glycol, Diethyl phthalate, Triclosan, Alcohol (95%V/V),Content 45%W/W , Contains 1% w/w Diethyl phthalate.

Harmful effects of ingredients:

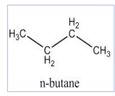
Hormonal and skin irritation effect of 'TRICLOSAN':
Triclosan is readily absorbed into human skin and oral mucosa and found in tissues and fluids in the system. TCS effects on endocrine disruption were reviewed previously (Wang and Tail 2015;Ruszkiewicz etal).
It might be harmful to the *immune system.*
Is Triclosan Cancer causing?
As a xenoestrogen, triclosan can displace estradiol from its receptors and potentially increase exposure to estradiol, which has been a risk factor identified for the development of breast cancer. This mechanism also has been shown to play a role in the development of breast cancer. This mechanism also has been shown to play a role in the development of ovarian cancer in in vitro studies.



Harmful effects of ' BUTANE ' & 'ISOBUTANE '
Is Isobutane harmful for skin?
> Isobutane can affect you when inhaled.
> Isobutane vapour can irritate and burn the skin and eyes.
> Contact with the liquid can cause frostbite.
> Inhaling Isobutane can irritate the nose and throat.

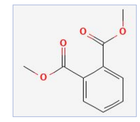


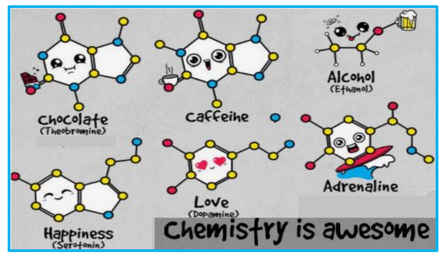
What are the side effects of inhaling butane? Chronic headache, Sinusitis , Ataxia (lack of muscle coordination , Dizziness, Shortness of breath, Nosebleeds, Chronic or frequent cough , Depression.
Is butane toxic to humans?
The toxicity of butane is low. Huge exposure concentrations can be assumed in butane abuse. The predominant effects absorbed in abuse cases are the effects on central nervous system (CNS) and Cardiac effects.



Effect of n-Butane on skin: An aerosol spray which contained n-butane as propellant, was reported to cause deep frostbite symptoms in the skin when sprayed directly on it. In conclusion, exposure to low concentrations of n-butane has not been reported to cause adverse effects in humans. It is anesthetic to both humans and experimental animals.

Harmful effects of ' PHTHALATES - *Physical problems caused by Phthalates:*
In the past few years, researchers have linked Phthalates to asthma, attention-deficit hyperactivity disorder, breast cancer, obesity and type II diabetes, low IQ , neuro-developmental issues, behavioral issues, autism spectrum disorders, altered reproductive development and male fertility issues.





Polythene

(Anit Paul & Souvik Agasti , Sem-III, Department of Chemistry)

Introduction
Polyethylene or polythene is the most common plastic in use today. It is a polymer, primarily used for packaging (plastic bags, plastic films and containers including bottles, etc.). As of 2017, over 100 million tonnes of polyethylene resins are being produced annually, accounting for 34% of the total plastics market.

History
Polyethylene was first synthesized by the German chemist Hans von Pechmann, who prepared it by accident in 1898 while investigating diazomethane. He and his friends recognized that it contained long $-CH_2-$ chains and termed it polymethylene.The first industrially practical polyethylene synthesis was again accidentally discovered in 1933 by Eric Fawcett and Reginald Gibson at the Imperial Chemical Industries (ICI) works in Northwich, England.

Property
The properties of polyethylene can be divided into mechanical, chemical and thermal properties.
Mechanical property : Polyethylene is of low strength, hardness and rigidity, but has a high ductility and impact strength as well as low friction. It shows strong creep under persistent force, which can be reduced by addition of short fibers. It feels waxy when touched.
Thermal property : For common commercial grades of medium- and high-density polyethylene the melting point is typically in the range 120 to 130 °C .The melting point for average commercial low-density polyethylene is typically 105 to 115 °C.
Chemical property : Polyethylene consists of nonpolar, saturated, high-molecular-weight hydrocarbons. polyethylene is partially crystalline. Polythene have excellent chemical resistance, meaning that they are not attacked by strong acids or strong bases and are resistant to gentle oxidants and reducing agents. Polyethylene absorbs almost no water. It can become brittle when exposed to sunlight.

Manufacturing processes
The ingredient or monomer is ethylene (IUPAC name ethene), a gaseous hydrocarbon with the formula C_2H_4, which can be viewed as a pair of methylene groups ($-CH_2-$) connected to each other. Ethylene is usually produced from petrochemical sources, but also is generated by dehydration of ethanol.

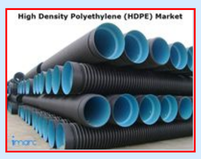
Polymerization
Polymerization of ethylene to polyethylene is described by the following chemical equation:
$n\ CH_2{=}CH_2\ (gas) \rightarrow [-CH_2{-}CH_2-]_n\ (solid)$
$\Delta H/n = -25.71 \pm 0.59$ kcal/mol
Ethylene is a stable molecule that polymerizes only upon contact with catalysts. The conversion is highly exothermic. Coordination polymerization is the most pervasive technology, which means that metal chlorides or metal oxides are used. The most common catalysts consist of titanium(III) chloride, the so-called Ziegler–Natta catalysts. Another common catalyst is the Phillips catalyst, prepared by depositing chromium(VI) oxide on silica.

Classification
Polythene is classified by it's density and branching.
High-density polyethylene (HDPE) : HDPE is defined by a density of greater or equal to 0.941 g/cm^3. HDPE has a low degree of branching. HDPE can be produced by chromium/silica catalysts, Ziegler–Natta catalysts or metallocene catalysts
Low-density polyethylene (LDPE) : LDPE is defined by a density range of 0.910–0.940 g/cm^3. LDPE has a high degree of short- and long-chain branching. LDPE is created by free-radical polymerization

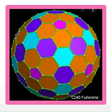
Use and environment problems
The primary uses of polyethylene are in packaging film, garbage bags, grocery bags, insulation for wires and cables, agricultural mulch, bottles, toys, and houseware. Polythene is also used in trays, fruit juice containers, milk containers, crates, and food packaging products.
The major impact of plastic bags on the environment is that it takes many years to for them to decompose. In addition, toxic substances are released into the soil when plastic bags perish under sunlight and, if plastic bags are burned, they release a toxic substance into the air causing ambient air pollution.

Reference

https://en.m.wikipedia.org/wiki/Polyethylene
https://web.archive.org/web/20100121071050/http://archive.thisischeshire.co.uk/2006/8/23/275808.html



In lieu of editorial - With this autumnal e-issue, ALCHEMY, strives to keep itself afloat, braving the turbulent pandemic wave. This issue features enthusiastic contributions from the young buds of the Department of Chemistry - some of them have blossomed into graduates and others are ready to bloom.
Greetings and good wishes, from the Department of Chemistry



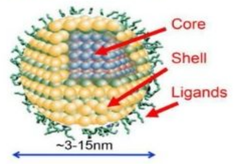
Quantum Dot Solar cell

By Sarwar Hasan (Chemistry Hons.), department of chemistry , Dum Dum Motijheel College .

Quantum dots (QDs) are semiconductor particles a few nanometres in size, having optical and electronic properties that differ from larger particles due to quantum mechanics. They are a central topic in nanotechnology.Quantum dots are sometimes referred to as artificial atoms. Potential applications of quantum dots include single-electron transistors, solar cells, LEDs, lasers, single-photon sources, second-harmonic generation, quantum computing, cell biology research, microscopy, and medical imaging .

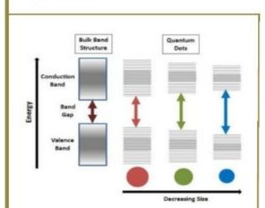
- Physical Structure of Quantum dot:-

1. The core is composed of the material that will be the emitting the pure .
2. The shell is made with different materials that protect the sensitive core from moisture & oxygen.
3. The ligands ,long chain molecule ensure that the quantum dot can be printed in a liquid during manufacturing, as well as play an important field in electronic properties.



What makes quantum dots unique?

In regular semiconductors like silicon (also known as bulk matter), the bands are formed by the merger of adjacent energy levels of a very large number of atoms and molecules. However, as the particle size reaches the nano-scale and the quantity of atoms and molecules decreases substantially, the number of overlapping energy levels decreases, causing the width of the band to increase. As Quantum dots are so tiny, they have a higher energy gap between the valence and conduction bands, compared to the bulk matter.Thus, the unique properties of quantum dots are explained by two nano-scale phenomena: quantum confinement effect and the discrete nature (quantized) of the electronic states of these particles.

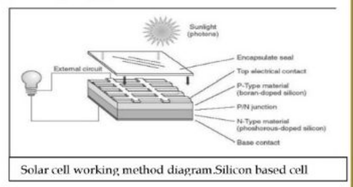


Splitting of energy levels in quantum dots due to the quantum confinement

Quantum confinement effect is the change in the atomic structure of the particle observed when the energy band is affected by the shifts in the electronic wave range. Because the wave range is comparable to the particle's size, electrons are constrained by the wavelength boundaries. Hence, quantum dots' properties are size-dependent, and their excitations are confined in all three spatial dimensions.Confinement energy is the key property of a quantum dot that explains the relationship between QDs size and the frequency of light they emit.

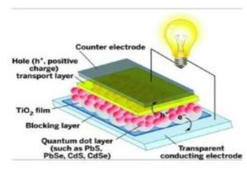
One of the application of Quantum dot is to increase conversion efficiency in solar cell:

A Quantum dot solar cell is a solar cell design that uses quantum dots as the absorbing photovoltaic materials.It attempts to replace materials such as copper indium gallium selenide (CIGS) or cadmium telluride (CdTe). Quantum dots have bandgaps that are tunable across a wide range of energy levels by changing their size, in bulk materials, the bandgap is fixed by the choice of material(s). This property makes quantum dots attractive for multi-junction solar cells, where a variety of materials are used to improve efficiency by harvesting multiple portions of the solar spectrum.
The band gap (1.34 eV) of an ideal single-junction cell is close to that of silicon (1.1 eV), one of the many reasons that silicon dominates the market. However, silicon's efficiency is limited to about 30% (Shockley–Queisser limit). It is possible to improve on a single-junction cell by vertically stacking cells with different bandgaps - termed a "tandem" or "multi-junction" approach. The same analysis shows that a two layer cell should have one layer tuned to 1.64 eV and the other to 0.94 eV, providing a theoretical performance of 44%. A three-layer cell should be tuned to 1.83, 1.16 and 0.71 eV, with an efficiency of 48%. An "infinity-layer" cell would have a theoretical efficiency of 86%, with other thermodynamic loss mechanisms accounting for the rest.
So with the help of this multi-junction approach we uses quantum dots in solar cell to increase Conversion efficiency .



Solar cell working method diagram.Silicon based cell

QDSC(Quantum dot solar cell):-A photon of light travelling into the cell and striking a quantum dot particle which in turn raises the energy of some of the electron in the (QDs) quantum dots . These excited electrons get injected into titanium dioxide and travel through it to the conducting surface of the electrode . While the electrons are travelling to the conducting surface of the electrode ,they leaves holes in quantum dots that need to be filled by others electrons . To fill these holes in QDs take electrons from electrolyte .The electron depleted electrolyte in turn takes electrons from counter electrodes . This process create a voltage different and produced current.



Advantages:-
With help of QDs solar cell become more efficient for current flow ,
Quantum dots have been found to emit up to three electrons per photon due to multiple exciton generation (MEG), as opposed to only one for standard crystalline silicon solar cell. Theoretically, this could boost solar power efficiencyfrom 20 % to as high as 65 %.

For beautification of the wall magazine few pictures have been inserted from: https://in.pinterest.com/