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Lithium-Transitioning Away from Fossil Fuels

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Abstract: *Fossil fuels are incredibly polluting, releasing high amounts of carbon dioxide and other greenhouse gasses responsible for the deregulation of the planet's environment. We are constantly in search of alternative and green fuels which will help us solve this problem. Now-a-days lithium metal is emerging and being utilized as a green option. Electric cars are significant contributors to climate protection. Lithium, an alkali metal is now powering the world's growing fleet of power-driven vehicles. It has often been cited as a key element in the transition away from fossil fuels. Lithium carbonate, a key component of lithium-ion batteries leads to sustainable transport and energy. Global development goals about clean energy can be achieved by adopting electric mobility, renewable power, and this will certainly lead circular economy. Lithium is intrinsically linked to those goals. Lithium can and will replace fossil fuels. This paper is a basic theoretical discussion about how this silvery-white metal replaces fossil fuels. The benefits of lithium, its distinguishing properties to make it a green fuel and the environmental impacts of use of lithium as a green energy source. This paper is a short review about the status and possibility of lithium to be used as a major energy source.*

Keywords: lithium, green fuel, sustainable transportation, energy storage and generation

I. INTRODUCTION

Energy drives economies and sustains societies. Energy production and use is also the single biggest contributor to global warming. The energy sector accounts for about two-thirds of global greenhouse gas emissions attributed to human activity. Fossil fuels are mainly used as source of energy till today. Fossil fuels are polluting, releasing high amounts of carbon dioxide and other greenhouse gasses during their consumption. It is responsible for the deregulation of the planet's environment. With the impacts of climate change beginning to be felt globally, and several reports warning of worsening consequences, global governments have collectively agreed to shift to a net-zero economic model. Goingnet-zero means achieving between the greenhouse gasses produced through human activity and those captured by naturea balance.

Our challenge is to reduce our reliance on fossil fuels to produce electricity and heat and power our transportation systems, while making reliable, clean and affordable energy available to everyone on the planet. Sustainable energy presents an opportunity to transform lives and economies while safeguarding the planet. The Geological Survey of India recently announced

that they had 'found' minerals bearing Lithium deposits, or 'Lithium inferred deposits' in Reasi district of Jammu. Even more impressively, the resources are estimated to contain around 5.9 million tonnes, which if confirmed would give India some of the world's largest proven deposits of Lithium after Australia, Bolivia, Chile and China.

This news takes our attention to lithium and its properties which makes it a green fuel. We need to think of it as a replacement to fossil fuels. Lithium is the lightest metal. Thus, an average 'AA' Lithium-Ion cell uses just a couple of grams of the element. Lithium-ion batteries power things like our phones and electric or hybrid vehicles. On cars, a nominal Lithium-Nickel Manganese Cobalt (LiNMC) battery uses just 70 grams of Lithium per kilowatt-hour. Lithium can be used in ceramics, greases and pharmaceuticals, but it's best known as the material in batteries for cell phones, laptops, EVs, smartphones, laptops, Air pods, electric toothbrushes, smartwatches, e- cigarettes, pacemakers and other devices.

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II. BASICS OF LI-ION BATTERIES

A Li-ion battery is constructed by connected basic Li-ion cells in parallel (to increase current), in series (to increase voltage) or combined configurations. A basic Li-ion cell consists of a cathode (positive electrode) and an anode (negative electrode) which are contacted by an electrolyte containing lithium ions. The electrodes are isolated from each other by a separator, typically microporous polymer membrane, which allows the exchange of lithium ions between the two electrodes but not electrons. In addition to liquid electrolyte, polymer, gel, and ceramic electrolyte have also been explored for applications in Li-ion batteries.

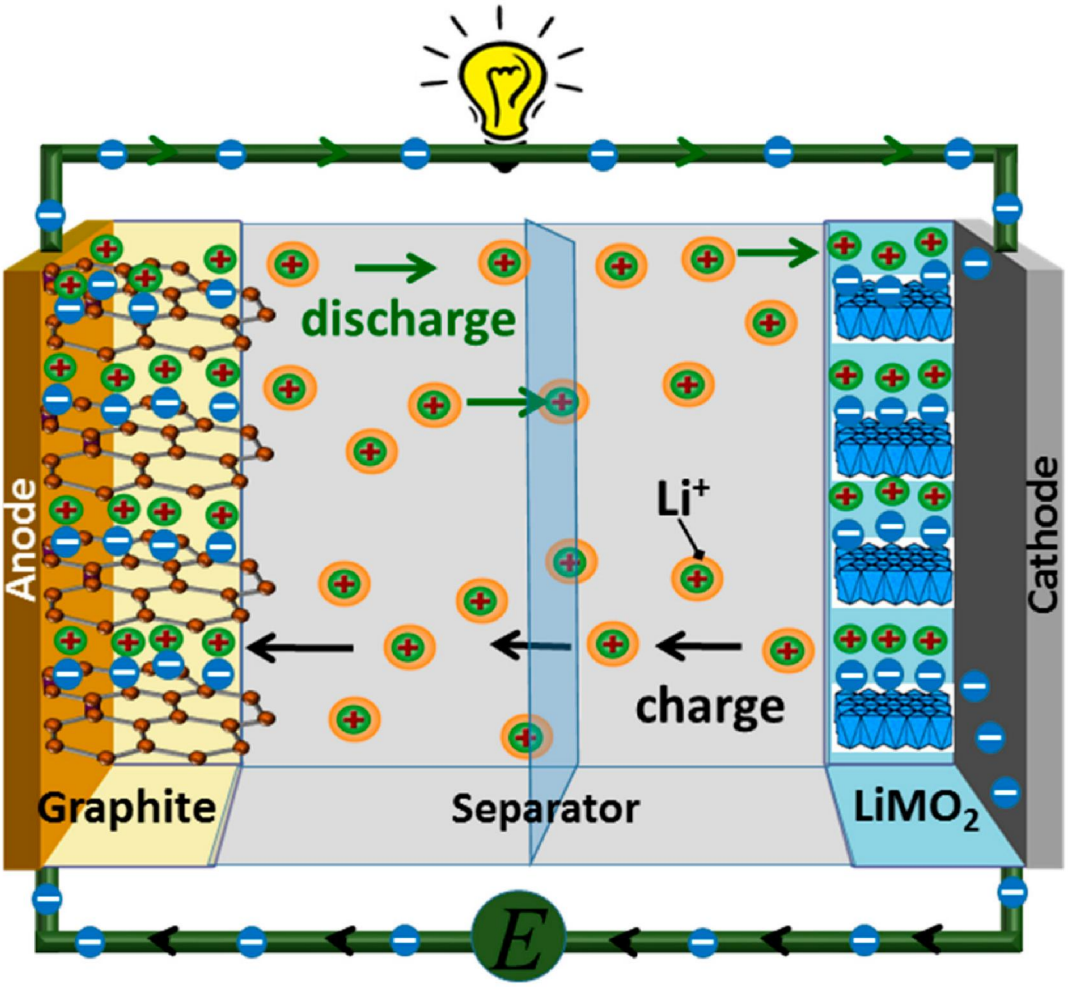

Figure illustrates the basic operating principle of a typical Li-ion battery cell. The discharged cathode materials (e.g., LiCoO2, LiFePO4) and anode materials (e.g., carbon) are stable in atmosphere. During charging process, the two electrodes are connected externally to an external electrical supply. The electrons are forced to be released at the cathode and move externally to the anode. Simultaneously the lithium ions move in the same direction, but internally, from cathode to anode via the electrolyte.

In this way the external energy is electrochemically stored in the battery in the form of chemical energy in the anode and cathode materials with different chemical potentials. The opposite occurs during discharging process: electrons move from anode to the cathode through the external load to do the work and Li ions move from anode to the cathode in the electrolyte. This is also known as “shuttle chair” mechanism, where the Li ions shuttle between the anode and cathodes during charge and discharge cycles.

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2.1 The Performance of Li-ion batteries

The performance of Li-ion batteries can be evaluated by a number of parameters, such as specific energy, volumetric energy, specific capacity, cyclability, safety, abuse tolerance, and the dis/charging rate.

- Specific energy (Wh/kg) measures the amount of energy that can be stored and released per unit mass of the battery. It can be obtained by multiplying the specific capacity (Ah/kg) with operating battery voltage (V).
- Specific capacity measures the amount of charge that can be reversibly stored per unit mass. It is closely related to number of electrons released from electrochemical reactions and the atomic weight of the host.
- Cyclability measures the reversibility of the Li-ion insertion and extraction processes, in terms of the number of charge and discharge cycles before the battery loses energy significantly or can no longer sustain function of the device it powers.
- Abuse tolerance is a critical requirement for practical application of Li-ion batteries, especially in electric vehicles. It includes mechanical, thermal, and electrical abuse valuations are carried out on prototypes to evaluate abuse tolerance of the batteries.

The mechanical abuse evaluation includes mechanical shock and drop, roll-over, nail penetration, and immersion in water tests.

The thermal abuse evaluation includes radiant heat, thermal stability, overheat, and extreme cold tests.

The electrical abuse evaluation includes short circuit, overcharge, over-discharge, and alternative current exposure tests.

Those abuse tolerance tests are extremely important for their applications in electric vehicles.

2.2 Advantages of Lithium

1. It is the lightest of all metals
2. Lithium is important in the transport and energy sector due to its high energy electrochemical potential.
3. Well-established extraction and processing infrastructure.
4. The relative low-cost of production.
5. Lithium-ion batteries are powerful, lightweight and of very high energy density, giving them a large storage capacity.
6. Its ability to recharge multiple times without losing its efficiency makes it the go-to energy storage system for EVs and renewable power.
6. Environment friendly power source.
7. Help to reduce their carbon foot print i.e. decarbonization goal may be achieved.
8.help to achieve SDG-Clean and affordable Energy.
9.Li-ion batteries are highly advanced as compared to other commercial rechargeable batteries, in terms of gravimetric and volumetric energy.

2.3 Disadvantages related Lithium

1. A major issue with lithium is its extraction process, which is non-sustainable
2. Utilizing traditional mining methods and water-intensive procedures, lithium mining has been linked to several environmental issues.
3. Innovators like EnergyX have identified key areas where the entire lithium extraction process can be made sustainable.
4. In addition to this, changing the status quo within the mining sector to account for more Environmental, Social, and Governance company strategies within extraction activities can go a long way in improving the overall sustainability of the product.
5.Small lithium batteries are safe but may cause injury if they have defects, are damaged, or are recharged improperly. However Battery management systems (BMS) are employed in battery cells/packs/modules to prevent any possible thermal runaway.
6.Fire incidents are reported in case of batteries which are not so deadly.

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III. CONCLUSION

lithium is a critical energy material in part due to an array of emerging technologies from electric vehicles to renewable energy systems that rely on large format lithium-ion batteries. The United Nations calls lithium "a pillar for a fossil fuel-free economy". remove fossil fuels can be replaced from our day-to-day lives by a different commodity, capable of changing the world for the better, and whose infrastructure and supply chains can be improved to become far more environmentally friendly.That's why we're working with governments to help them improve energy efficiency and increase the use of renewables in their countries and cities. We aim for sustainable energy to lay the foundation for resilient, low-emission economies and societies around the world. Use of electric vehicles promotes sustainable, low-emission transport and works to reduce the sector's contribution to air pollution and climate change. To meet the increasing demand for energy storage, particularly from increasingly popular electric vehicles, intensified research is required to develop next-generation Li-ion batteries with dramatically improved performances, including improved specific energy and volumetric energy density, cyclability, charging rate, stability, and safety.

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