The Lithium-Ion Battery

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Think of the time when the only phone you could use was attached to a cord with limited distance or the existence of a car that runs completely off the power of a battery was nowhere in thought. How about those batteries that could potentially explode if not handled properly? Due to the extensive research of many scientists to perfect the lithium-ion battery, the nightmares of the past seem almost nonexistent. Because of its slimmer design, the lithium-ion battery is just light enough to allow cellular phones to be more compact, making them easier to carry. It even helps make the modern-day hybrid vehicle's design fit the more practical world with its economical, yet stylish look (Bullis, n.d.). As we take a journey throughout time to the discovery of the use of the lithium-ion battery as a renewable energy source, we will also find out why this energy source is much safer and more efficient than most other batteries produced. The *Encyclopedia of Ecology and Environmental Management* defines a battery as a portable source of power made from a set of electrolytic cells, which consist of two electrodes in an electrolyte, forming a positive and negative pole. A chemical reaction is created when these two poles come in contact with one another through an outside electrical circuit producing a small voltage of energy ("Battery," 1998).

The very first findings of a cell current that could produce enough energy to provide an electrical current was discovered in the late 1700s by Volta. He proved that using two different metal types, such as zinc and silver, combined with liquid electrolytes, would produce a substantial amount of energy. Volta's findings intrigued many other different scientists to develop ways to store and use the energy produced from this cell. Over the next two centuries, advancements of battery energy sources would soar, thanks to the discoveries of these many scientists, such as Humphrey Davy in 1807, Michael in 1830, William Grove in 1839, Plante' in

1859, LeClanche' in 1868, Junger in 1899, and even Thomas Edison in 1901. The different type of cells created by each of these scientists would pave the way for other alternative energy produced by a battery (Thackeray, 2004).

The production of the first vehicle that runs off the power of a battery was introduced in the early 1900s. This was a short-lived dream because of its inability to increase to rapid speeds needed for long-distance travel like the internal combustion engine provided. Electric vehicles used nickel-iron batteries, which had an extended lifespan and were proven durable enough to withstand extreme temperatures and conditions, but were later replaced by the lead-acid battery used today primarily in forklifts, golf carts, and other vehicles that only require short-distance use. These batteries differ from those used in the hybrid electric vehicles because they have only a limited range of travel, due to their mass, before their energy is depleted and a potentially lengthy recharge is needed whereas hybrid batteries mostly use their energy to help accelerate the vehicle, and the fuel system aids in long-distance travel to preserve the batteries power allowing time for recharging (Thackeray, 2004).

The 1970s brought forth an interest in creating electric vehicles that could be driven long distances while also reducing pollution produced from fuel-burning engines. Since the lead-acid and nickel-iron batteries had not proven to be effective enough to produce the energy needed to power these vehicles, another energy source had to be discovered. Because of this, several new battery energy sources were produced, such as nickel-metal hydride batteries, high-temperature molten-salt systems, containing electrodes made of sodium or lithium, and the latest developed non-aqueous lithium-ion and lithium-polymer systems. In 1990, Sony Corporation in Japan introduced the rechargeable lithium-ion battery in hopes of

changing the future of technology. In fact, they were right. These batteries made using devices like laptops and cell phones more efficient, and they are also the reason that the "dot.com" industry was established (Thackeray, 2004). Although the lithium-ion battery had a positive impact on the advancement of the technology, there was a problem with its significant contribution to pollution when discarded, according to the *Encyclopedia of Ecology and Environmental Management* ("Battery," 1998).

Researchers are working to find a way to increase the lithium-ion battery's energy source and decrease any safety issues. One safety measure being used is the installation of a costly fuse on the inside of the battery to prevent fire or explosion (Bullis, n.d.). Changes to the internal components, such as the electrolytes and electrodes, have been attempted by scientists to find a more cost efficient, yet still safe, way to produce the battery. Materials that seemed to be less dangerous or reactive, such as aluminum, tin, or silicon, have been used as conductors, but failed because each of the materials expands during the discharge and recharge cycles of the battery, making it difficult for lithium-ions to circulate freely throughout each of the cells. Michael M. Thackeray of Argonne National Laboratory states he and his colleagues have developed lithium-based anodes containing only copper and tin that allow a free flow of lithium-ions because they don't change form much during operation, making the need for the expensive safety fuse to be installed void (Gorman, 2000). This development will not only increase the energy produced by the lithium-ion battery, but will also decrease any safety issues that may arise during use.

Alan Gotcher, Ph.D., President and CEO of Altair Nanotechnologies, Inc., spoke about new advances being made by his company to perfect the lithium-ion battery. Altairnano, as

Gother refers to as the trade name in his speech, is a business that specializes in developing nano-structured metal oxides to enhance new product developments. Gotcher says that his company is working to develop the most advanced lithium-ion battery in the world. A battery able to contain enough power to increase the rate of speed of a vehicle quickly, recharge in minutes instead of hours, and has ability to function in temperatures below zero degrees and above 100 degrees, has a lifespan that last almost five time longer than the average battery, up to at least 15 years or better, and also contains no hazardous chemicals, making this battery extremely safe for use in any product big or small:

> I believe it will take such a major breakthrough in electrical storage and power management if our country is to make tangible, near-term achievements in reducing our nation's increasing dependence on foreign sources of petroleum and natural gas, and thereby enhancing national security, while also reducing the amount of carbon dioxide and other greenhouse gases that are produced by our growing energy consumption without curtailing our growing economy. It will be a major factor in reducing the wasteful use of energy and is the key to migrating transportation using liquid fuel to electricity (Gotcher, 2006).

Gotcher also states that the battery's ability to operate safely in any weather condition allows it to be used in places that generally could not use the lithium-ion battery because of the risks. It also has no hazardous issues, such as exploding or catching fire, when it comes to the disposal of the battery. Gotcher discusses how the advanced lithium-ion battery produced by his company will be a great asset to helping the US advance into the next world of hybrid

vehicles that will still have the same capabilities as the fuel-burning automobile, such as carrying five or more passengers or traveling long distances. He explains,

> It means safer, quieter, non-polluting that perform as well or better than today's vehicles. It means that the vast amounts of money required for new refineries, or for a national hydrogen fueling system, or for liquid natural gas terminals can be diverted to other purposes, private and public. Some of the money would be used to accelerate research into clean coal and to speeding up deployment of renewable energy technologies and improving them," says Gotcher (2006).

Michael Spear, controller of Battery Warehouse, says that there once was a simple time when batteries were only needed for a car, motorcycle, boat, or flashlight, but since the development of so many different battery types, his stock has become more complicated. Spears says that his store now has at least 83 different types of batteries used for powering cell phones, 55 different cordless phone batteries, and a countless number of individual batteries used to power various electronic items. Battery sales have increased tremendously throughout the years because people have to spend more money to power things like cell phones, watches, even cameras, which has been one of the biggest electronics to change its design over time. With the advances being made to the battery energy source, the camera has been allowed to transform from one that was more costly with the purchase of film and batteries to a smaller, stylish digital photo capture, meaning no film purchase is needed, and the battery can be recharged without hassle (Mirabella, 2004).

From century to century, many scientists have tried to develop a full-proof form of renewable energy that is both safe and efficient. Could this source of energy produced from

the lithium-ion battery be the cause of a “blast” into an advanced technological world? Today, we are able to reap the benefits of the many contributions made to these studies by scientists to make this energy source useful to the environment while reducing pollution and waste rates across the world. Because of these advancements, more hybrid cars are being produced for travel than in earlier decades and have not deviated from the original style of the automobile as stated by Alan Gotcher in his Congressional speech. Many more people are able to make purchases to different electronic items, such as cellular phones, digital cameras, notebook/pads and laptops for their convenience because advanced studies of the lithium-ion battery have made them less expensive due the a lengthy lifespan and its ability to be recharged. What does the future technology world hold for this renewable energy source? If things continue to advance in the way that it has over centuries, is it possible we could live in a world much similar to that of the children’s cartoon “The Jetsons”? Only time will tell.

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