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https://doi /10.1088/978-0-7503-4881-2ch1

The first chapter presents an overview of the key concepts, brief history of the advancement in battery technology, and the factors governing the electrochemical performance metrics of battery technology. It also includes in-depth explanations of electrochemistry and the basic operation of lithium-ion batteries.

To understand how batteries have changed through time and the potential for continued growth, it is vital to understand their basic functions, types, components, and performance criteria. The following sections in this chapter discuss the working mechanism of ECCs, the various types of batteries, battery components, fundamental terminologies, and important factors that will enable the development of a new battery technology.

Batteries are typically classified into two broad categories: primary batteries and secondary batteries, according to the structure of ECCs that they hold.

Primary batteries (PBs) are single-use, non-rechargeable batteries as they store and give energy but cannot be recharged. They must be discarded after use since the chemical process that creates electricity while in use cannot be stopped. These batteries are frequently used in household items like radios, watches, remote controls, toys, and other items that don't require a lot of energy. These are produced in accordance with international standards and are affordable, secure, low maintenance, and practical to use.

Examples: dry cell and alkaline battery.

A dry cell need not be dry, rather it consists of an electrolyte in the form of paste. Although it can be used in either direction, the issue of electrolyte leakage is a significant barrier to long-term storage. Zinc-carbon batteries are the most common example. Alkaline batteries have more energy storage capacity and less electrolyte leakage than zinc-carbon batteries. They usually use potassium hydroxide, an alkaline electrolyte. They cost more than zinc-carbon batteries but perform better in extreme weather conditions. Examples include lithium-MnO_2, silver oxide, and alkaline-MnO_2.

Secondary batteries (SBs) are multi-use rechargeable batteries because they constantly store and supply energy over numerous charging and discharging cycles. Utilizing an external current, the chemical reaction that

generates electricity can be reversed while in use. They are often used in portable consumer devices such inverters, telephones, computers, cameras, etc.

There are various types of SBs, depending on the electrolyte used and the electrodes" chemical composition. Both wet and dry cells can be SBs. The lead-acid battery, which uses electrodes of lead alloy and lead oxide as well as diluted sulfuric acid as the electrolyte, is the most common example of a wet cell with a liquid electrolyte. The lithium-ion battery used in computers and mobile devices is the most common illustration of a dry cell with electrolyte in the form of paste. The usage of SBs in hybrid electric vehicles is one of the fascinating new applications nowadays. Nickel-metal hydride (NiMH), nickel-cadmium (NiCd), and nickel-zinc (NiZn) batteries are some examples of SBs that are used often.

Thus, the Daniell cell is composed of two half cells of which neither works alone. After that at around 1859, a French physicist, Gaston Plant?, invented the lead-acid battery, which was the first rechargeable battery to be commercially produced. It comprises lead alloy as the anode and lead oxide as the cathode immersed in dilute sulfuric acid electrolyte. During discharge, a chemical reaction occurs at both electrode surfaces as shown in equation (1.4), which leads to the formation of lead sulfate in the cell.