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ENERGY STORAGE TECHNOLOGIES

The concept of energy storage plays a key role in today’s world, where the pursuit of energy efficiency, sustainability and environmental safety is

becoming increasingly important. With the growing demand for energy and the need to reduce greenhouse gas emissions, research and development of new energy storage methods is becoming a priority for the scientific community and industry. This is exemplified by various types of energy storage, such as batteries, supercapacitors, thermal storage, chemical batteries, and others.

Let's look at a conventional battery. As we know, a battery is a secondary chemical source of reusable electricity that can be recharged after being discharged. A battery consists of such important parts as: the case, which is the protective shell of the battery; electrodes - positive and negative electrodes for storing and delivering energy; terminals - contact points for connecting to a device or charger; and protective circuits, which include electronic systems to monitor the battery's current and voltage to prevent overheating and overcharging.

Like any electrochemical cell, a battery consists of two electrodes immersed in an electrolyte solution and separated by a membrane to prevent short circuits. The electrodes are either plates of an active material or plates of a conductive material on which the active material is coated. The electrolyte can not only provide charge and mass transport, but also directly participate in electrochemical reactions. A battery has both advantages and disadvantages. One of the advantages is that they are ideal for small mobile devices such as smartphones and laptops, as well as for electric vehicles and for storing energy from renewable sources such as solar and wind power. Although batteries have a lower energy density than some other energy sources, they still provide a significant amount of energy for their size and weight. In addition, there is a major disadvantage - batteries can have a limited lifespan, can be heavy, and require proper disposal due to the presence of harmful substances.

Let's move on to supercapacitors. This is another promising device for storing electricity. In terms of their characteristics, supercapacitors occupy an intermediate position between traditional electrolytic capacitors and rechargeable batteries. High performance, energy capacity, and reliability make it possible to use supercapacitors both as part of various electrical equipment (e.g., uninterruptible power supplies, backup power plants, peak power balancing systems) and as stand-alone power sources. In addition, there are positive characteristics such as: it is an environmentally friendly energy source that is less polluting than other traditional capacitors; it has lower requirements for circuit structure and does not need to be equipped with special charging and discharging control circuits, but during the use of capacitors, overcharging and overdischarging are affected. In addition to the advantages, there are some disadvantages to this approach. While supercapacitors are an environmentally friendly energy source, they can be subject to overcharging and overdischarging, which can affect their lifetime and efficiency. In addition, their integration into electrical systems may require additional charge and discharge management equipment, adding to the overall cost and complexity of the system.

Rechargeable batteries, also known simply as batteries, are sources of electrical energy that work on the basis of chemical reactions. They are also widely used in a variety of devices, from simple electronic devices such as small lamps to more complex ones such as laptop computers and cell phones. They have the following advantages: they are important sources of energy for a wide range of electronic devices; they are relatively simple to use and easy to carry, making them ideal for portable devices; many types have a long shelf life and can be stored without significant loss of capacity. Disadvantages include: some types can be sensitive to temperature changes or react negatively to mechanical damage, which can lead to leakage or even explosion; the cost of constantly replacing or recharging chemical batteries can be high, especially for devices that require frequent energy use; and they can be inefficient compared to other energy sources, such as fuel cells.

By looking at different types of energy storage, such as batteries, supercapacitors, and chemical batteries, we can see their advantages and disadvantages. Batteries, while providing a significant amount of energy for their size and weight, have a limited lifespan and must be disposed of due to their toxic content. Supercapacitors, despite their advantages in charge and discharge rates, also have efficiency and system integration issues. It is therefore important to continue research into energy storage and develop new technologies that are more efficient, sustainable and environmentally friendly. This will allow us to ensure a sustainable and efficient energy future for our society.