Development and verification of distributed-charging-systems for LiFePO4 batteries

歐陽杰、蔡耀文

E-mail: 322051@mail.dyu.edu.tw

ABSTRACT

As the increasing requirements of the green energy industry, the major battery and car companies have made efforts in the developments of electric vehicles. The related developments of its charge systems and hardware equipments would become the most important key point. The effective applications of vehicle energy have become the major topic. The basic characteristics requirement of modern battery for electric vehicle (EV) includes high energy density, fast charge and discharge, high power output, and long cycle life. For this reason, the main research point of this thesis is the charging system of LiFePO4 batteries for EV. In charging and discharging processes, it will result in unbalance state of charge (SOC) due to the distinct characteristics of each battery in the battery strings. An unbalance SOC of the battery strings not only can reduce its cycle life, but also will result in insufficient electric power. Therefore, an energy balance system should be established to resolve the above problem. This thesis has focused on a new design system of distributed-charging-systems for LiFePO4 batteries balance charging control. A novel distributed charging design with SOC balance property is introduced for series connected battery strings. The new design is also applied to an EV system. The distributed-charging-system is divided into three parts: 1.Steady-state charge: design a novel circuit to reduce the unbalance SOC problem of the discharge procedure in driving. A steady-state charge circuit is build. 2.Dynamic charge: design a distributed charging circuit for regenerative braking control of electric vehicles. The SOC balance function is also established in this distributed charging circuit. 3.Static charge: use the same circuit structure of steady-state charge and dynamic charge, static charge function is also designed while stopping the car. The static charge circuit can replenish battery capacity rapidly. Experimental results demonstrated to achieve the objective of the full charging functions. The distributed-charging-system cannot only limit the application to LiFePO4 battery of vehicles, it can also apply to any kind of real-time electricity generation systems.

Keywords : Lithium Iron Phosphate Battery、LiFePO4 Battery、S.O.C.、Energy Balance、Electric Vehicles

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