Characteristics of large scale electrode of graphene supercapacitor for Power grid energy storage system

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Abstract

Supercapacitor have high power performance and long lifetime, it is very adaptable to apply a Frequency Regulation(F/R) in power grid. Supercapacitor can complement low battery power performance and it is possible to reduce the size and installation of batteries for frequency regulation. Because hybrid system utilization between supercapacitor and battery in a system can potentially eliminate the need for short-term frequent replacement as required by batteries, hence, saving the resources invested in the upkeep of the whole system or extension of lifecycle of batteries in the long run of power grid. [1]

However, energy density in supercapacitor still low that can not be apply sufficiently to hybrid energy storage system to cover the short term frequency regulation. So, it is far from being able to replace batteries and struggle in meeting the demand for a high energy density. In these day, graphene considered as an attractive material to improve energy density much more than commercial activated carbon in electrode fabrication because graphene has excellent conductivity, stability, and high surface area. [2] But, graphene production methods are easy to aggregate or stack and lead to reduce surface area and it is very difficult to maintain an excellent graphene property for electrode production in case of large scale area for mass production. So, graphene electrode in large scale still need to be examined closely for high performance in order to apply for commercial energy application.

In this study, in order to optimization of energy and power density properties in large scale electrode, we conducted various production condition for component of electrode fabrication. We assembled the electrode in a dry room which has a relative humidity under 2% and constant electrode thickness over 100um was manufactured for stable mechanical strength and electro chemical properties. The organic and ionic liquid, which has an electorchemical window from 3.0V and 3.5V respectively, was used as the electrolyte each condition for optimization of specific capacitance. To minimize of contact resistance, graphene electrode was conducted hot compression process from room temperature to 75℃. The capacitance retention of graphene supercapacitor were periodically measured at 5℃, 25℃, 45℃, 65℃ in thermostatic chamber and cycle life performance was conducted under specific temperature conditions, respectively. As a results, we manufactured large scale electrode of 3540 pouch type and Φ60 cylindrical type in graphene supercapacitor. we discuss various electrode issues in fabrication for application in energy storage system of power grid.

References

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