Study on the application of graphene supercapacitor for energy storage system in power grid

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Supercapacitor, especially electrical double-layer capacitance(EDLC), have many advantage that can operate at very high charge and discharge rates and have lifetimes of over a million cycles [1]. Furthermore, supercapacitor can complement batteries to reduce the size of batteries using with frequency regulation. Their utilization in a system can potentially eliminate the need for frequent replacement as required by batteries, hence, saving the resources invested in the upkeep of the whole system in the long run of power grid. However, supercapacitor are still far from being able to replace batteries and struggle in meeting the demand for a high energy density [2].
Since electrode material is the main key to improve the energy density, today, graphene considered as an attractive material because graphene has excellent conductivity, stability, and high surface area [3]. However, many aspects of the electrochemical behaviour of electrode still need to be examined closely in order to apply for electrode for commercial use, and there is another issue that graphene production methods are easy to aggregate or stack and lead to reduce surface area. In this reason, it is very difficult to maintain an outstanding graphene property for electrode production in case of large scale area for mass production.
In this study, in order to practical application, we compared various electrode properties of activated carbon and activated graphene. To demonstrate the electrochemical performance of the activated carbon and graphene electrode, we manufactured a series of supercapacitor on CR2032 coin cells. The samples were punched into round electrodes of 12 ㎜ in diameter. Two symmetric electrodes were isolated using an ion-porous separator. The organic liquid, which has an electorchemical window from 2.2 to 3.0V, was used as the electrolyte. Also, minimization of IR drop in graphene supercapacitor was conducted by current collector modification. The capacitance retention of graphene supercapacitor were periodically measured at 25℃ in thermostatic chamber.
Finally, we discuss various issues for application of graphene supercapacitor in energy storage system of power grid.

References

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