Development of Electrode Materials with Controlled Composition for High Energy Li-ion Supercapacitor

Jenn-Yeu Hwang, Li-Duan Tsai, Chun-Lung Li, Chung-Hsiang Chao, Jason Fang

Material and Chemical Research Laboratories, Industrial Technology Research Institute, Chutung, Hsinchu, Taiwan

Supercapacitor is an energy storage device with higher energy density than electrolytic capacitor and higher power density than battery. Its energy can be well stored through either electrostatic charge separation (double layer capacitance) or interfacial charge transfer (pseudocapacitance), but is still not high enough to fulfill the long-duration applications. To increase energy of supercapacitor, a higher working voltage is desired.

Conventional supercapacitors used to have the design with symmetric electrodes, both positive and negative electrodes made from the same materials. Recently, the use of asymmetric electrodes in supercapacitor starts to be considered as the most effective way to boost energy density [1-4].

In this study, we demonstrate a series of new asymmetric supercapacitor with a controlled composition which can help to achieve higher voltage, higher energy, and also better rate capability. The proposed supercapacitor generally comprises activated carbon as positive electrode, aluminum as negative electrode, and Li salts as electrolyte. With this new configuration, the asymmetric supercapacitor is able to achieve higher working voltage (Max. 3.9~4.0V) and higher energy density (2~3 times) than symmetric type.

In addition, the new Li-ion supercapacitor also shows promising high rate capability at various C-rates (89.5%@10C, 78.5%@30C, and 69.5%@60C, capacity retention XC/1C). Even when the device is tested at 150C, a reasonable capacity retention (50%) can be obtained (Fig. 1).

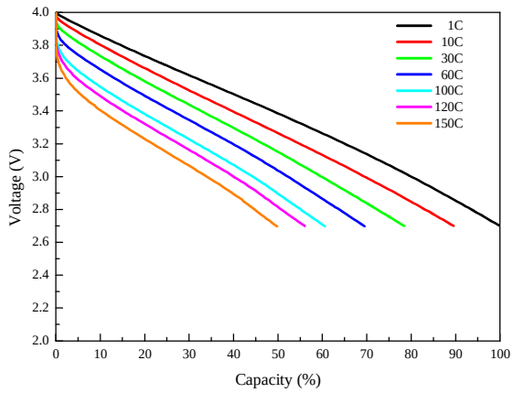

Figure 1. The discharge curves of the asymmetric supercapacitor at various C rates (1C to 150C).

Reference

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