Fabrication and capacitive property of carbon spheres in hydrothermal carbonization method

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Carbon materials have been widely used for energy and environmental field, such as electrode materials, catalyst supports and adsorbents. Electric double layer capacitor (EDLC) is attracting attention as an energy storage system. The control of pore structure in carbon electrode is important for enhancement of capacitive property. Carbon spheres are easily synthesized by hydrothermal carbonization of glucose in aqueous solution [1]. We have analyzed the structure of carbon spheres synthesized by hydrothermal carbonization of glucose and measured the capacitive properties [2]. In this study, the effect of alkaline activation was investigated in order to make small pores in carbon spheres and to enhance the capacitive properties for the application of EDLC.

Glucose was used as carbon source. Glucose was dissolved into water and then the solution was sealed into an autoclave and heated at 200°C. After hydrothermal treatment, the obtained products were filtered off, washed with water and ethanol, and dried at 50°C. The heat treatment was carried out in N_2 at 200-1100°C. Furthermore, alkaline activation was carried out with NaOH and KOH mixture. The morphology of products was observed by SEM. XRD, Raman, FT-IR and N_2 adsorption were measured in order to clarify the change in the internal structure of carbon spheres before and after heat treatment and alkaline activation. Charging/discharging measurement was carried out under a constant current mode using electrode plate.

Figure 1 shows the SEM images of products synthesized by hydrothermal carbonization after heat treatment at 800 °C. Carbon spheres have been synthesized by hydrothermal carbonization of glucose and subsequent alkaline activation. The particle morphology did not change even after alkaline activation but super-micropore (0.7-2.0 nm) was development. The capacitive property of the carbon spheres was enhanced with an increase in meso-pore volume by alkaline activation. The suitable pore structure was fabricated in carbon spheres by the control of synthetic conditions, leading to high capacitance even at high current density.

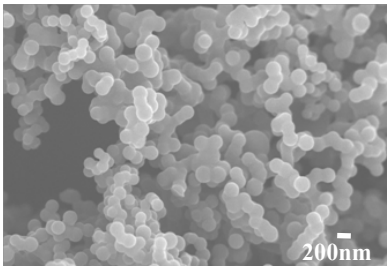

Fig.1 SEM images of products synthesized by hydrothermal carbonization after heat treatment at 800 °C.

References:

[1] Q. Wang, et al., *Carbon*, **39**, 2211 (2001).
[2] M. Inada, et al., *Adv. Powder Tech.*, **28**, 884-889 (2017).