Electrochemical activation of vertically grown graphene nanowalls synthesized by plasma-enhanced chemical vapor deposition for high-voltage supercapacitors

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Abstract

This work demonstrates the electrochemical activation of graphene nanowalls (GNWs) for both negative and positive electrodes of high-voltage (≥ 3.7V) (figure 1), organic electrical double-layered capacitors (EDLCs). A plasma-enhanced chemical vapor deposition (PECVD) method is employed to vertically grow graphene nanowalls. The crystallinity and layer number of GNWs can be controlled by the synthesis variables such as precursor flow rate and pressure. The material characterization includes Raman spectra, scanning electron microscopy, and X-ray diffraction analysis. Cyclic voltammetry (CV) is employed to promote the charge storage capacity of GNWs in 1 M tetraethylammonium tetrafluoroborate / propylene carbonate (TEABF4/PC) between 2 and -3 V (vs. Ag/AgNO3). Anions and cations in the electrolyte are respectively intercalated into the layered structure of GNWs at sufficiently positive and negative potentials, raising the space of graphene layers (figure 2). Several parameters of cyclic voltammetry (e.g., potential window, cycle number, activation time, etc.) are investigated to achieve the highest specific capacitance. The results reveal that after the electrochemical activation at 25 mV s1 from 0 to þ2 V and from 0 to 3 V for 10 cycles, the specific capacitance of most few-layer graphene nanowalls is doubled. [1]

References

[1] Da-Je Hsu, Yu-Wen Chi, Kun-Ping Huang, and Chi-Chang Hu, and Kun-Ping Huang, Electrochim. Acta., 300 (2019) 324

Figures

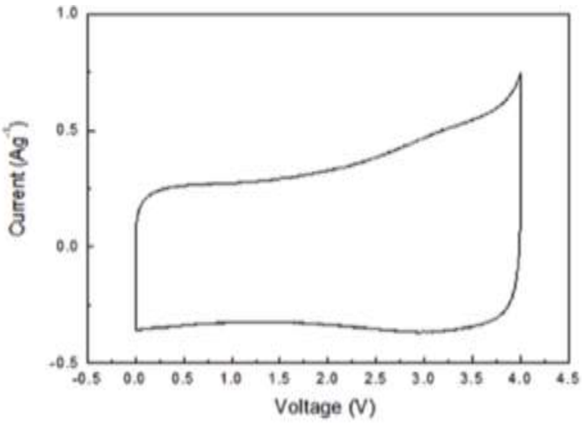

Figure 1 is the CV curve with a high cell voltage of 4 V at 25mV s_1 in 1M TEABF4/PC, showing a very rectangular shape, indicating good SC behavior.

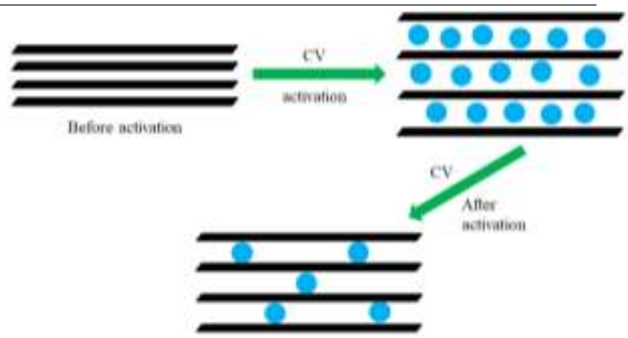

Figure 2: The mechanism of electrochemical activation.