High-Voltage Graphene Nanowalls Supercapacitor

Kun-Ping Huang[1]
Yu-Wen Chi[1,2], Da-Je Hsu[2], Chi-Chang Hu[2]

[1]*Mechanical and Mechatronics Systems Research Laboratories, Industrial Technology Research Institute, 195, Sec. 4, Chung Hsing Road, Chutung, Hsin-Chu 31040, Taiwan, R.O.C.*
[2]*Department of Chemical Engineering, National Tsing Hua University, 101, Section 2, Kuang-Fu Road, Hsin-Chu 30013, Taiwan, R.O.C.*

kphuang@itri.org.tw

Abstract

The microwave plasma enhanced chemical vapor deposition tool is used to grow vertical graphene nanowalls (GNW) and nitrogendoped GNW (NGNW) electrodes in one step (Figure 1). The superior performances of an asymmetric EDLC consisting of a negative NGNW/Ti electrode and a positive GNW/Ti electrode in Figure 2 reveal the successful development of a high performance, 4.2 V EDLC in 1 M TEABF4/PC. In Figure 2a, the CV curves of this full cell in 1 M TEABF4/PC with the cell voltage varying from 3 to 4.2 V at 50 mV s^{-1} are generally symmetric and rectangular in shape, revealing an ideal EDLC with excellent reversibility. Figure 2b shows the charge−discharge curves of this asymmetric cell at different cell voltages. The highly symmetric curves of this cell at various cell voltages strongly support the performance of high-voltage graphene nanowalls supercapacitor. [1]

References

[1] Yu-Wen Chi,Chi-Chang Hu, Hsiao-Hsuan Shen, and Kun-Ping Huang, Nano Lett., 16 (2016) 5719

Figures

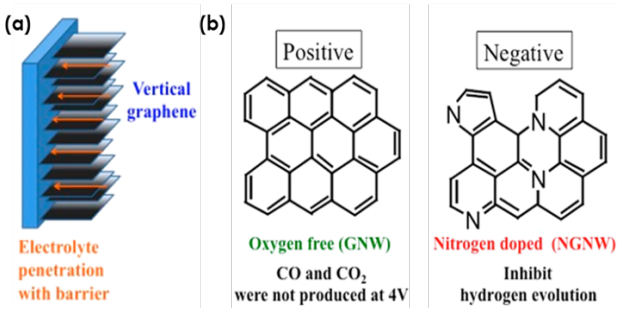

Figure 1: (a) The electrodes, GNW/Ti and NGNW/Ti display a binder-free, vertical structure, the penetration of electrolytes and electron transport in the whole graphene matrix. (b, left) The oxygen-free, binder-free GNWs circumvent the issue of oxygen-functional group removal, which are inert to the irreversible oxidation of organic electrolytes, enlarging the upper limit of working potential window. (b, right) The uniform N doping on the binder-free, vertical NGNWs significantly depresses the irreversible reduction of residual water and organic electrolyte at the negative potential end, further enlarging the working potential window.

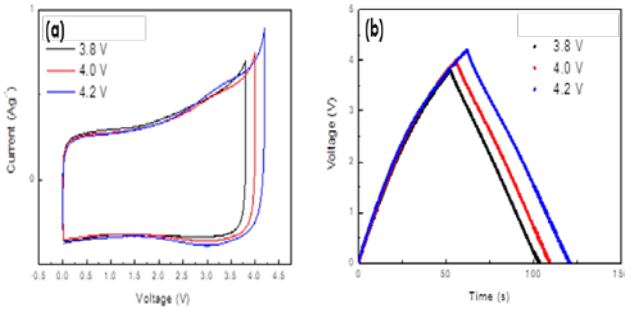

Figure 2: (a) CV curves of an asymmetric EDLC consisting of a positive GNW/Ti electrode and a negative NGNW/Ti electrode in 1 M TEABF4/PC with cell voltage of 3.0, 4.0, and 4.2 V at 50 mV s^{-1}. (b) The constant-current charge−discharge curves of the above asymmetric EDLC in 1 M TEABF4/PC with a cell voltage of 3, 4.0, and 4.2 V at 2.0 A g^{-1}.