Research on Graphene Planar Capacitor Technology

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Abstract: Micro-capacitance scale graphene capacitors were prepared by spray coating on a soft film, and two performance tests were performed. Firstly, it was tested by charge and discharge test by Xinwei battery charge and discharge tester, and it was found to have super-capacitor characteristics of short charging time and long discharge time. Secondly, the flexible test shows that the physical deformation does not have a large impact on the planar capacitance, which proves that the flexible performance of the capacitor is better.

1. Introduction

A large-capacitance microcapacitor prepared on a soft film, which has good charge and discharge performance, exhibits a low-resistance graphene planar supercapacitor, and a graphene planar supercapacitor prepared on a soft film has good flexibility, and In the case of stretching and bending, the effect on the capacitance is small, and a large capacitance can still be maintained.

1.1 Technology Introduction

Obtain a large capacitance with micro-capacitance, good charge-discharge performance,the steps are as follows:

(1) Prepare a planar capacitor template, using a fork shape. To reduce the surface area of the capacitor and increase the capacitance per unit area, the width of the graphene line is 0.8 mm, the total width is 20 mm, the length is 30 mm, and the surface area of the capacitor is 5 cm 2 .

(2) Prepare the appropriate ratio of raw materials, we use graphene, molybdenum disulfide, polymer conductive polymer, purified water (excluding impurities), metal compounds (ferric chloride, copper nitrate, copper powder, silver nitrate) according to Mix a certain ratio and mix well.

(3) The obtained raw materials are applied to A4 paper by a spraying method (Fig. 1), and dried at a certain temperature. Using sodium borate solution as the electrolyte, it can be used as a capacitor to participate in experiments and measurements.

(4) The prepared capacitor was passed through an electrochemical workstation, and the Xinwei battery charge and discharge tester was used to test the cyclic voltammetry curve and the charge and discharge curve.

(5) According to the measurement results, the graphene planar supercapacitor is improved and optimized.

Figure 1. Flexible Graphene Planar Capacitance

1.2 Graphene Manufacturing Steps

Making graphene by electrochemical stripping method: using two graphite rod-electrolyte solutions to form a conventional two-electrode system, and then performing chemical stripping under constant voltage to prepare graphene, as shown in Fig. 2:

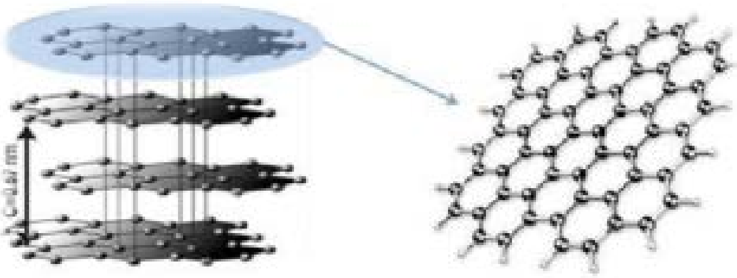

Figure 2. Electrochemical stripping to prepare graphene

Making graphene by thermal expansion and contraction method: dissolve graphite into dichlorobenzene by heating, and then cool the graphite polymer by red melt in the first step, and then cool through the second step. It is self-polymerized into a single layer of graphene.

Applying ultrasonic stripping method to make graphene: This method fixes highly oriented pyrolytic graphite between two upper and lower substrates, and uses transverse vibration of graphene by ultrasonic waves to form a graphite layer through van der Waals force. The bond is broken and the graphene is separated.

2. Experimental Test

Flexible supercapacitors can be arbitrarily changed shape, which has more flexibility than traditional stereo capacitors. It can spray materials such as graphene onto plastic soft film to make it have good stretchability, flexibility. The use of planar capacitors in different environments requires less space shape.

In order to better reflect the change of the performance of the planar capacitor under physical deformation, we carried out the tensile test, the bending test and proposed the improvement of the planar capacitance. The physical deformation of the plane capacitance is shown in Figure 3:

Figure 3. Flexible performance of planar capacitance under physical deformation

2.1 Flexible Test

In order to obtain the capacitance retention rate of the planar capacitor in the case of deformation, we performed a deformation test, as shown in Figure 4:

Figure 4. Deformation test of plane capacitance

By measuring the capacitance of different winding turns on a cylinder with a diameter of 5mm and comparing the size, it is found that as the number of winding turns increases, the capacitance only shows a slight attenuation, indicating that the bending cause little influence on the capacitance. The effect of the relationship between the capacitance retention rate and the number of winding turns during bending is shown in Figure 5:

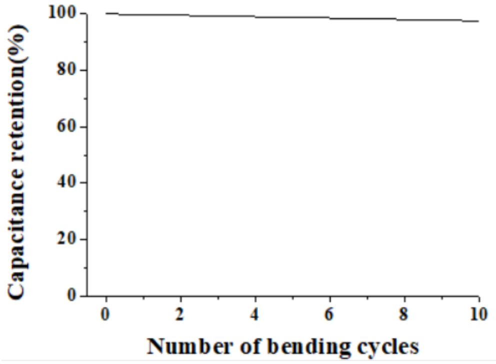

Figure 5. Capacitance retention ratio and winding number

The performance of the capacitor is sTable under deformation conditions, indicating that the physical deformation does not have a large impact on the planar capacitance, which proves that the flexibility of the capacitor is good.

2.2 Charge and Discharge Test

We used the Xinwei battery charge and discharge tester to charge and discharge the supercapacitor. Set three steps, first set it on for 5s, then enter the constant voltage and constant current step. The voltage is set to 0.6v, 0.8v, 1v. The current is set to 0.002A, and finally enters the shelving step again. It can be found that the capacitor reaches 0.46v after constant voltage constant current charging, and the charging time is short, the discharge time is long, and the characteristics of the super capacitor are met, as shown in Fig. 6. , Table 1 and Table 2:

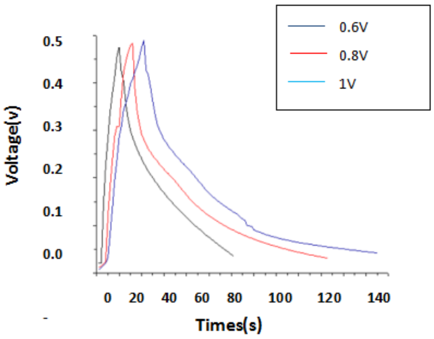

Figure 6. Charge and discharge curve (voltage versus time curve)

Table 1. Changes in voltage over time during constant current charging

Time s	2	3	4	5	6	7	8	9	10
Voltage v	0.121	0.241	0.326	0.385	0.441	0.478	0.513	0.537	0.556

Table 2. Changes in voltage over time during constant current discharge

Time s	11	14	17	20	26	41	50	61
Voltage v	0.503	0.424	0.374	0.341	0.293	0.212	0.175	0.135

As can be seen from the above Table, this capacitor is charged from 0.121v constant current to 0.556v after 10s charging, and then discharged from 0.503v constant current to 0.135v after 50s discharging.

3. Experimental Results

Compared with the traditional three-dimensional capacitor, the graphene planar capacitor is more porTable, lighter and more flexible. At the same time, it can also realize the characteristics of super capacitor fast charging and slow release. The following results can be summarized through experiments:

(1) The graphene planar supercapacitor screen printed on the soft film has good stretchability, flexibility, flexibility, and has little effect on the capacitance under the condition of stretching, and can still maintain a large capacitance.

(2) It has ideal capacitance, and different capacitance values can be obtained at different scanning speeds of the electrochemical workstation. The capacitance value of 1060μF/cm2 can be obtained at 10mv/s, and 232.8 can be obtained at the scanning speed of 50mv/s. The capacitance value of μF/cm2, and the potential capacitance value decreases as the scanning speed increases.

(3) The charging and discharging performance is ideal. After 10 seconds, it can be charged to nearly 0.5V, and the discharge must be completed after at least 60 seconds. The charging and discharging curves are different under different charging voltages and charging currents. Both reflect the fast charge and slow release characteristics of graphene supercapacitors.

References

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