Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

An All-in-one Supercapacitor with High Stretchability via a Facile Strategy

Yihe W, Chi L, Guochen J, Ruofei H and Junping Z*

Tianjin Key Laboratory of Composite and Functional Materials, School of Materials Science and Engineering, Tianjin University, Tianjin 300350, People's Republic of China.

*Corresponding author: jpzheng@tju.edu.cn

1. Morphology of PANI aerogel

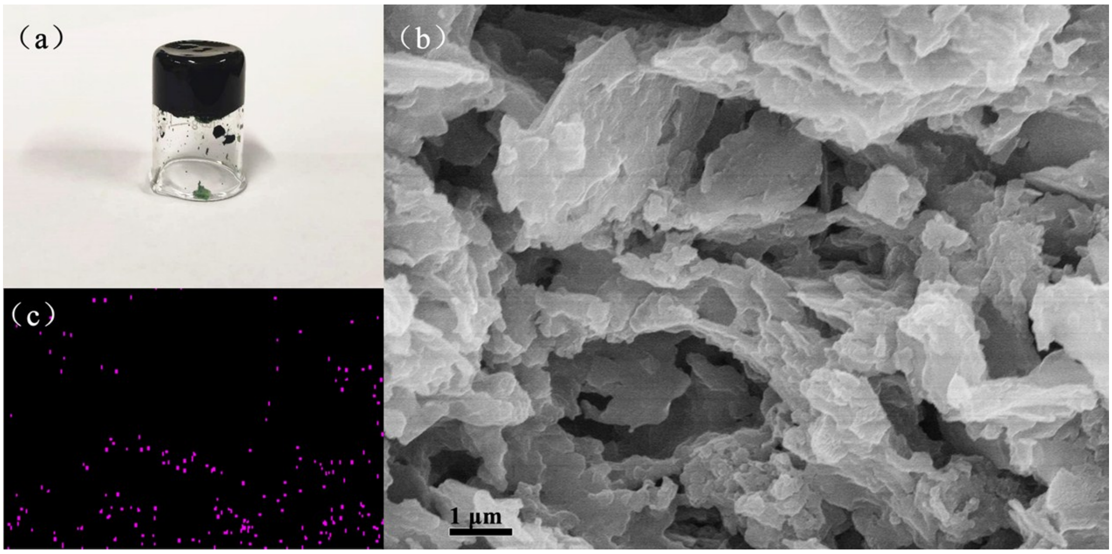

Figure S1 Morphology of PANI aerogel: (a) PANI hydrogel before freeze-drying; (b) PANI aerogel; (c) the mapping of N element.

The morphology of PANI prepared by the method is shown in Figure S1. Figure S1(a) is the optical image of the PANI hydrogel formed after stirring for 4 h. After freeze-drying, the PANI aerogel powder was prepared successfully. Figure S1(b) shows the three-dimensional structure of PANI. It can be seen more clearly that the N element structure is formed as presented in figure S2(c). The pores further represent the 3D structure of PANI, which predicts that the better performance of PANI.

2. **Morphology of pure sliver film**

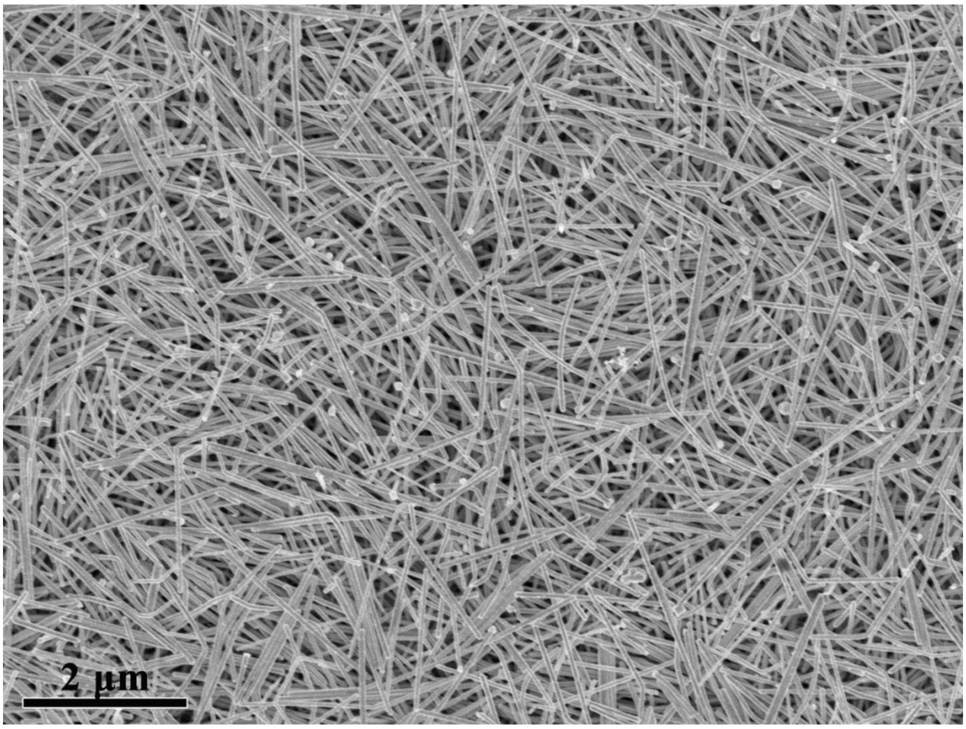

Figure S2 SEM image of sliver film.

The SEM image of pure sliver film can be compared with the electrode surface pressed into the silver nanowires. It can further reflect the PVA polymer matrix in figure 2, and the silver film did not destroy the structure of electrode.

3. **Mass ratio of PANI in electrode**

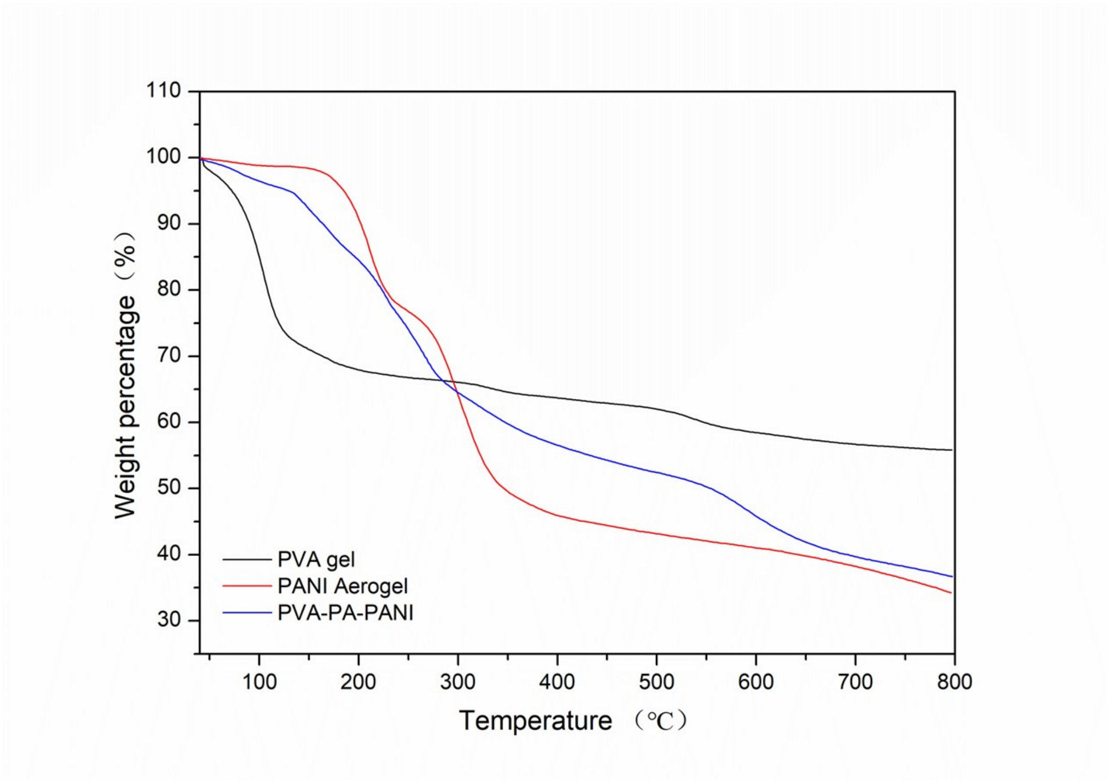

Figure S3 TGA curves of electrode.

For the all-in-one supercapacitor, PANI is the main active energy storage material of the electrode, so it is necessary to ensure that PANI accounts for the main proportion in the electrode composite. PANI accounts for more than 90% in PVA-PA-PANI, which meets the expected requirement according to the TGA curves.

4. **Electrochemical properties**

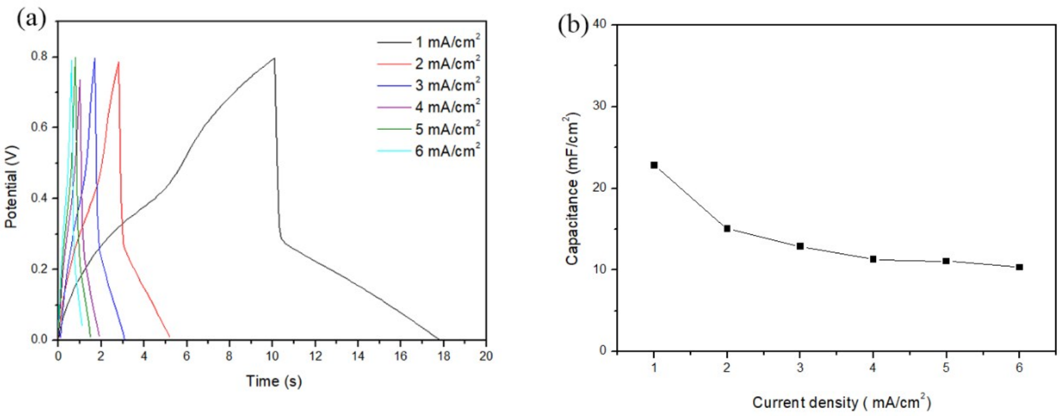

Figure S4 Galvanostatic charge-discharge curves with increasing current densities.

As shown in figure R1, the Galvanostatic charge-discharge (GCD) curves were used to evaluate the rate capability of all-in-one supercapacitor. The areal specific capacitance (C_s, mF/cm^2) was obtained according to the following equation:

C=(2It)/(SV)

where V is the potential window (V); I is the constant discharge current (mA/cm^2), S is the areal of the electrode (cm^2); t is the discharging time.

The capacitance degrades with increasing of the discharge current, and when the current increased 6 times from 1 mA/cm^2 to 6 mA/cm^2 , the capacitance decreased to drops to 40% of original area capacitance. Conducting polymers such as PANI used as the electrode materials of pseudocapacitors which have rapid redox-based charge-discharge behavior. However, because of participating in electrical chemical reactions, PANI would undergo structural damage and other irreversible changes, which lead to poor stability and low rate capability. PANI is the only active material in our electrode, the stability and rate capability are not good enough in the all-in-one supercapacitor. In the further study, we would introduce other component in the electrode which can improve the properties. This paper is a guideline for the series of research in all-in-one supercapacitor.