CRUMPLED GRAPHENE AS HIGH PERFORMANCE SUPERCAPACITOR

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ABSTRACT

This research paper shows how crumpled graphene paper is use to fabricate extremely stretchable and high-performance super capacitors.Super capacitors are promising for unconventional energy-storage devices. Here, a simple and low-cost method is studied to fabricate these supercapacitors.For high specific capacitance, Graphene paper with high packing density of graphene and nano-porous structure is used. The graphene paper is attached on an uniaxially or biaxially elastomer film which is stretched to its original dimensions.High capacitance and reliability of the electrode under several cycles of large deformation maintained by flexibility and high toughness of the graphene paper.

Keywords: Crumpled Graphene Paper, Stretchable Supercapacitors.

I INTRODUCTION

Recent advances in materials science and electronics have boomed a nascent field of unconventional stretchable electronics, which can sustain large deformations and conform to surfaces with complicated geometries while maintaining normal functions and reliability [1-8]. Various stretchable electronic devices have been developed for different applications, such as stretchable circuits [9], loudspeakers [10], pressure and strain sensors [11], stretchable transistor [12], epidermal electronics and implantable medical devices[13]. Since most of the unconventional electronics run on electricity and electrical-energy-storage devices that can be integrated and deformed together with unconventional electronics have become unavoidable in achieving fully power-independent and stretchable systems for realistic applications. This paper has brief study of how crumpled Graphene is used as a stretchable and high performance super capacitor. Super capacitors are promising for unconventional energy-storage devices. Available stretchable super capacitors are limited by their low stretchability, high cost and complicated fabrication process. Here, we study a simple and low-cost method to fabricate extremely stretchable and high-performance super capacitors based on new crumpled-graphene papers.

TheGraphene is a crystalline allotrope of pure carbon with 2-dimensional propertiesin the form of a very thin, nearly transparent sheet. Graphene can be described as a one-atom thick layer of graphite. It is remarkably strong for its very low weight, it is 100 times stronger than steel [14] and it conducts heat and electricity with great efficiency

[15]. It was first produced in the lab in 2003[16]. Because it is virtually two-dimensional, it interacts oddly with light and with other materials. Graphene research has expanded quickly since the substance was first isolated in 2004. Research was informed by theoretical descriptions of graphene's structure, composition and properties. High-quality graphene also proved to be surprisingly easy to isolate, making more research possible. Graphene is a zero-gap semiconductor.

II WORKING DISCRIPTION

1.1 Crumpling of Graphene paper

Fabrication ofhigh-performance and extremely stretchable supercapacitors based on novel crumpled-graphene-paper (CG-paper) electrodes, fabricate graphene paper with high packing density of graphene (~1.33 g cm^{-3}) and nano-porous structure is used which result in its high specific capacitance[17-18] The graphene paper is then attached on an uniaxially or biaxially elastomer film that has been stretched to 1.5 ~ 5 times of its original dimensions byZ Jang et al. proposed Fabrication of crumpled-graphene papers shown in figure 1[19].Thereafter, as in the elastomer the pre-stretches are relaxed, the lateral dimensions of the attached graphene paper reduce by the same ratio as those of the elastomer film (Figs. 1a–c). Microscopically, the graphene paper is folded and crumpled into patterns as shown in Figs. 1e and f due to the localized mechanical instabilities [20-22]. The CG-paper unfolds, enabling extremely high stretchability of the CG-paper electrode when the elastomer film is stretched back. In addition, the flexibility and high toughness of the graphene paper maintains high capacitance and reliability of the electrode under several cycles of large deformation. The graphene paper can maintain its integrity and electric conductivity over multiple crumpling or unfolding cycles, enabling extremely robust and stretchable electrodes for supercapacitors.

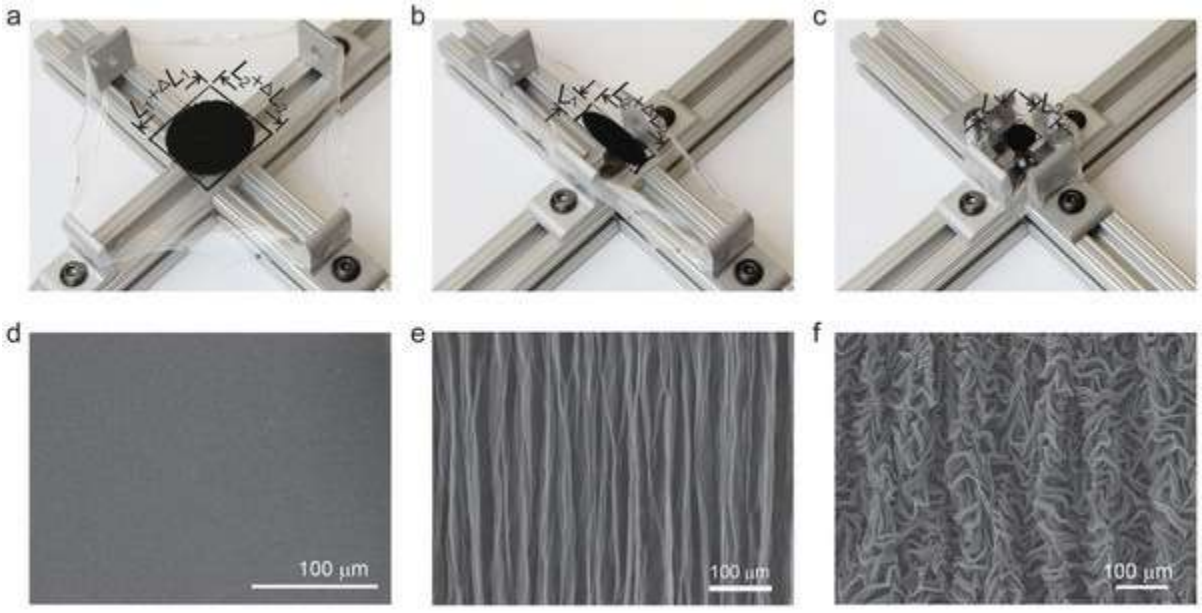

Figure 1: Crumpled-graphene papers [19]

III ADVANTAGES

- In comparison with batteries, supercapacitors have the advantages of fast charge/discharge rate and long operating life, and therefore represent a very promising candidate for energy-storage devices in unconventional electronics.
- Supercapacitors have relatively simple fabrication processes and low costs.

IV CONCLUSION

Flexible electronics has become an inevitable part of electronics. Capacity of energy storage in capacitor can be increase by using Graphene as electrodes. Many people are exploring graphene paper.It is good for making supercapacitors, which can easily be folded, bent, or stretched to as much as 800 percent of its original size. It provides an extremely simple but highly effective concept to make stretchable electrodes for supercapacitors by controlled crumpling of multilayered graphene films.

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