Graphene Electrodes for Better-Performance Supercapacitors

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Recently, a research group led by Prof. WANG Zhenyang from the Institute of Solid State Physics of the Hefei Institutes of Physical Science (HFIPS) reported a novel method to prepare high-performance supercapacitors with ultra-high energy storage density.

Constructing 3D graphene frameworks with ultra-thickness and rich ion transport paths is of great significance for the practical application of graphene supercapacitors. However, in thicker electrodes, the overall energy storage capability is limited by insufficient delivery of ions to the electrode material surface and the poor electron transport properties.

In this work, laser-induced ultra-thick 3D graphene frameworks, with thickness up to 320 µm, were directly grown on the synthesized polyimide by optimizing the thermal sensitivity of polyimide to increase laser penetration depth. Thus, hierarchical pores were obtained due to the fast liberation of gaseous products during laser radiation, which facilitated fast ion transport.

This new structure well balanced the contradiction between electrode thickness and fast ion transport. Pseudocapacitive polypyrrole was further introduced into the graphene frameworks to prepare composite electrodes, which show specific capacitances as high as 2412.2 mF cm-2 at 0.5 mA cm-2.

Accordingly, fexible solid-state micro-supercapacitors were constructed with a high energy density of 134.4 µWh cm-2 at a power density of 325 µW cm-2.

These results endue the ultra-thick graphene electrodes with great potential in the application of supercapacitors which promise high energy storage density.

Fig.1. Schematic illustration for the improved laser inducing growth process of ultra-thick 3D graphene frameworks with hierarchical pores.

Fig. 2. Morphology and structure characterizations of the ultra-thick 3D graphene frameworks.

Fig.3. Electrochemical performance of the supercapacitors.

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