

# Graphene electrodes for better-performance supercapacitors

November 11 2020, by Zhang Nannan

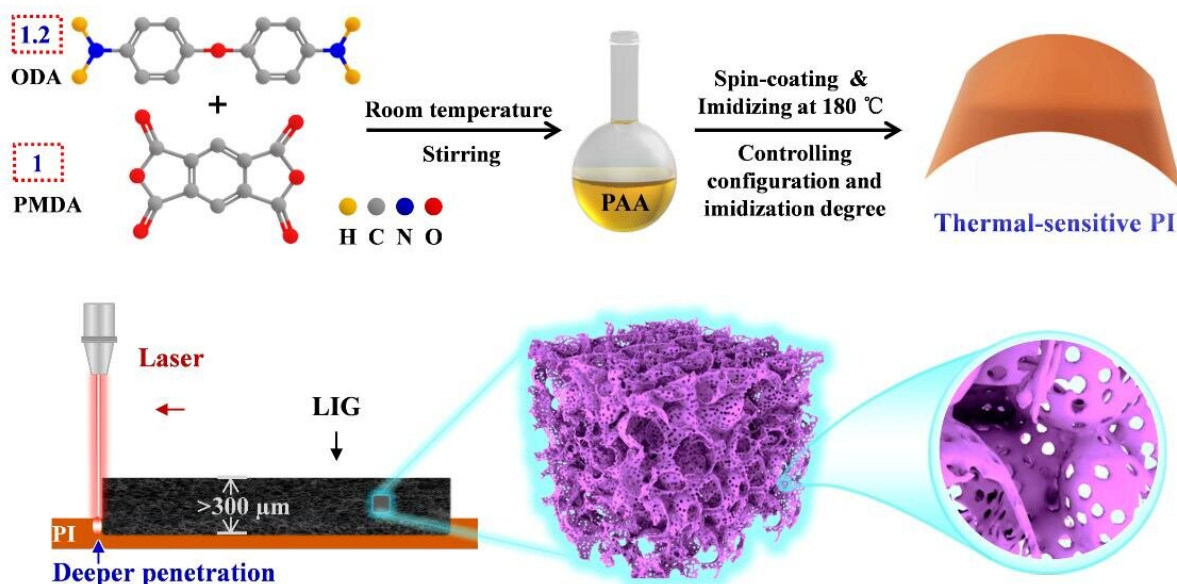


Fig.1. Schematic illustration for the improved laser inducing growth process of ultra-thick 3D graphene frameworks with hierarchical pores. Credit: LI Nian

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 3-D [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 3-D graphene frameworks, with thickness up to 320  $\mu\text{m}$ , 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  $2412.2 \text{ mF cm}^{-2}$  at  $0.5 \text{ mA cm}^{-2}$ .

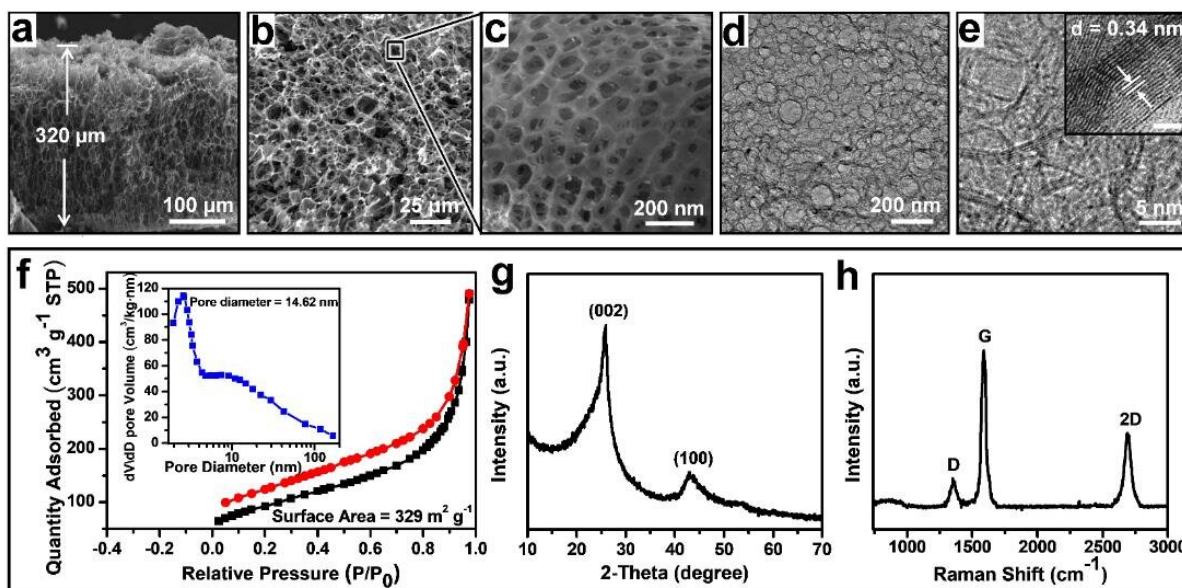


Fig. 2. Morphology and structure characterizations of the ultra-thick 3D graphene frameworks. Credit: LI Nian

Accordingly, flexible solid-state micro-supercapacitors were constructed with a high energy density of  $134.4 \mu\text{Wh cm}^{-2}$  at a power density of  $325 \mu\text{W cm}^{-2}$ .

These results show that these ultra-thick graphene electrodes hold great potential in the application of supercapacitors which promise high energy storage [density](#).

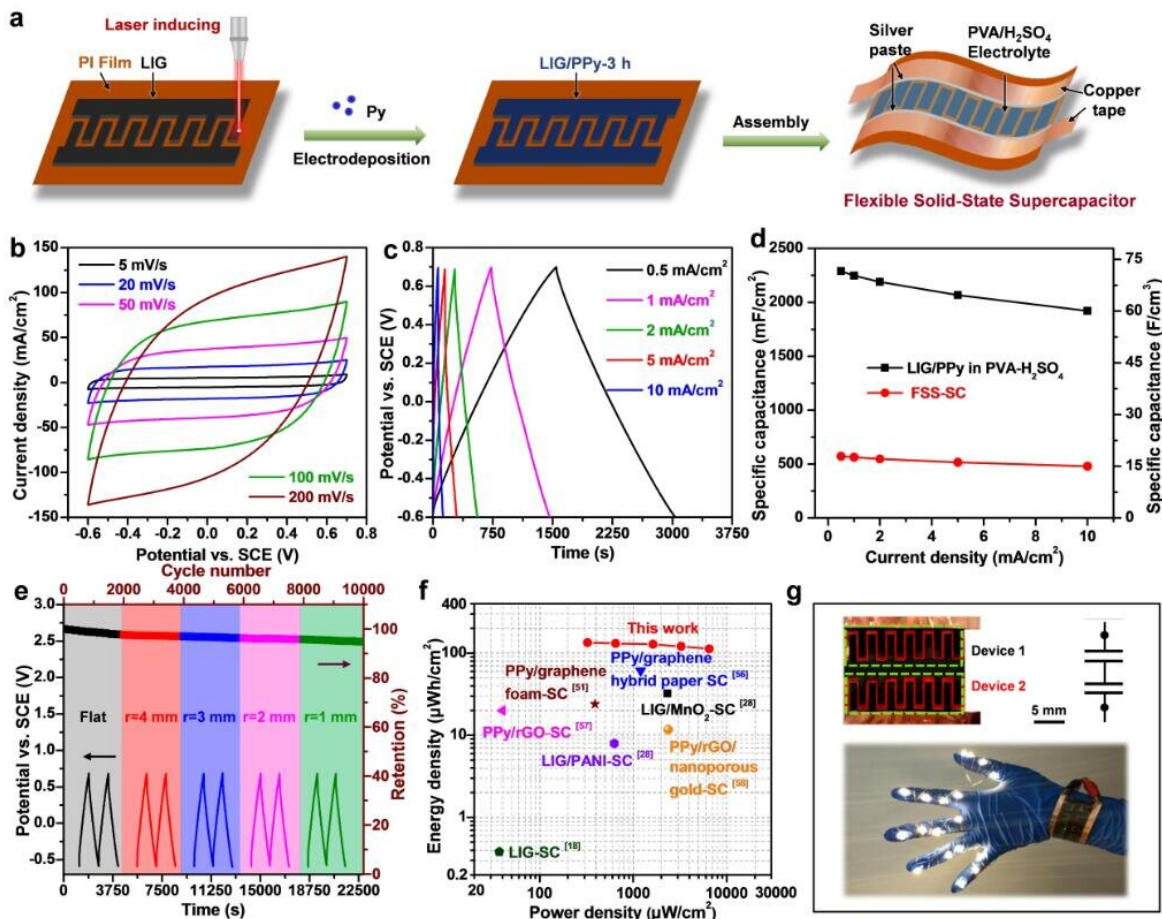


Fig.3. Electrochemical performance of the supercapacitors. Credit: LI Nian

**More information:** Xinling Yu et al. Ultra-thick 3D graphene frameworks with hierarchical pores for high-performance flexible micro-supercapacitors, *Journal of Power Sources* (2020). DOI: [10.1016/j.jpowsour.2020.229075](https://doi.org/10.1016/j.jpowsour.2020.229075)

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