“High Performance Supercapacitor Based on Laser Induced Graphene for Wearable Devices”

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Abstract

To ensure maximum comfort for the wearer, electronic components that include energy harvesters need to be mechanically conformable. In this context, we demonstrate a versatile, cost-effective and efficient method for fabricating graphene supercapacitor electrodes using Laser Induced Graphene (LIG). A CO2 laser beam instantly transforms the irradiated polyethersulfone polymer (PES) into a highly porous carbon structure. The LIG method was used to deposit graphene layers on graphite sheets to produce the supercapacitor electrodes. Graphene formation and morphology were examined and confirmed using several techniques including Scanning Electron Microscopy (SEM), Energy Dispersive X-ray (EDX) spectroscopy, Raman Spectroscopy and Fourier transform infrared spectroscopy (FTIR). Moreover, the electrochemical characterization was performed in different electrolytes (NaOH and KOH). At 5 mV s^{-1}, the LIG electrode achieved 165 mF cm^{-2} and 250 mF cm^{-2} in NaOH and KOH electrolytes, respectively. Consequently, we show that a wearable symmetric supercapacitor device with LIG electrodes achieved 98.5 mF cm^{-2} at 5 mV s^{-1} in KOH electrolyte. The device demonstrated an energy density of 11.3 _Wh.cm^{-2} with power density of 0.33 mWcm^{-2} at 0.5 mA cm^{-2}. The retention of capacitance was 75% after 2000 cycles, with outstanding performance for the comparable graphene-based electrodes. These results further validate the use of LIG for developing flexible energy harvesters for wearable applications.

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