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Communication

All-solid-state pseudocapacitive micro-supercapacitors from laser-treated polymer derivatives

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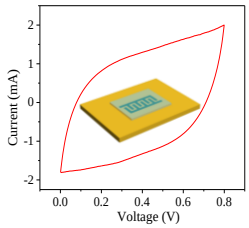
Graphical Abstract



A simple method utilizing laser writing technology to fabricate all-solid-state micro-supercapacitors was reported. The solid-state micro-supercapacitors based on MnO_2/graphene nanocomposites deliver high volumetric capacitances, promising energy density, good stability and low leakage current.

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ABSTRACT

We report a simple method for fabricating all-solid-state micro-supercapacitors, utilizing laser writing technology. Porous graphene films with three-dimensional networks induced by laser from commercial polymer was acted as scaffold for loading MnO_2, a typical pseudocapacitive materials. Using gel electrolyte, all-solid-state pseudocapacitive micro-supercapacitors were fabricated. Compare to traditional printing and lithography techniques produced micro-supercapacitors, the as-fabricated devices demonstrate high volumetric capacitances, good stability and low leakage current, indicating a scalable and facile approach for future energy storage devices in portable microelectronics.

Supercapacitors and batteries are considered as the most promising energy storage devices for electric vehicles and renewable energy systems [1,2]. Among them, supercapacitors, combined with exceptionally long cycle life and high power density, afford a smart strategy [3-6]. As a burgeoning architecture, micro-supercapacitors are of significant importance expecting to couple with micro-batteries in various applications, including AC line-filtering, microelectromechanical system and portable electronics [7-11]. Although they can be fabricated using printing and lithography techniques [12-14], continued improvements in low-cost and scalability are required to realize their future commercialization. Recently, Tour *et al.* report a scalable approach for producing porous graphene films with three-dimensional networks from commercial polymer films using laser irradiation, and they have equipped the graphene in micro-supercapacitors systems [15-18].

Here, we combine the laser irradiation process with subsequent electroless deposition of pseudocapacitive materials for the fabrication of all-solid-state micro-supercapacitors. A CO_2 laser is first used to convert the polyimide (PI) into porous graphene with interdigitated architecture, which works as conductive matrix for the deposition of pseudocapacitive materials. Manganese dioxide (MnO_2) representing pseudocapacitive transition metal oxides is chose *via* self-limiting electroless deposition. All-solid-state micro-supercapacitors are fabricated with the interdigitated electrodes using gel electrolyte. The fabricated devices exhibit many advantages in performance such as high capacitance, long lifetime and low leakage current.