All Screen-Printable Solid-State Microsupercapacitor Integrated by Nanostructured Graphene/CNTs Hierarchical Electrodes

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Abstract

Micro supercapacitors(MSCs) is an emerging energy storage devices, where the extremely high charge/discharge rate and high energy and power density, as well as high flexibility, make it a promising candidate toward wearable and on-chip electronics. However, most of the reported works integrate MSCs by micro-fabricating technology, which involves complicated and vacuum process, various chemical west, and high cost, hindering it for cost-effective and scalable production. Here we present an all-screen-printable method for fabricating all-solid(PVA: H_3PO_4) and flexible MSCs by rational designed composite electrodes of electrochemical exfoliated (EC-)graphene and long single-walled carbon nanotubes(CNTs). The systematic investigations are carried out on various electrode patterns, thickness, and the ratio of graphene/CNTs. A specific areal capacitance of 11.8 mF/cm^2 and specific stack capacitance of 118 F/cm^3 (at 5 mV/s)was achieved, which was superior to most of reported MSCs. Moreover, it exhibits a high cycling stability of 98% retention after 1000 cycles. It shows 90.2% capacitance sustention when the bending angle up to 180^o, indicating excellent mechanical flexibility and operation stability. The extracted energy and power density of 16.4 mWh/cm^3 and 294.8 W/cm^3, which was, to our best knowledge, the highest performance for ultra-thin(<5 um) MSCs. This work provides a scalable and cost-effective method to produce solid-state MSCs with high energy density.

References

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Figures

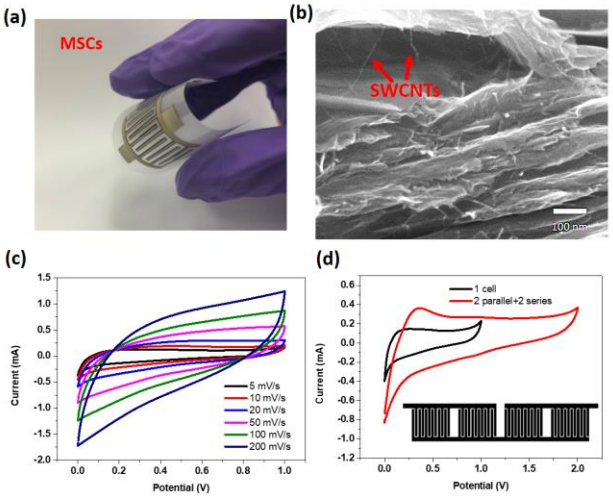

Figure 1: (a)Single cell of all screen-printable MSCs. (b) Typical morphology of graphene/SWCNT hybrid electrode. (c) Electrochemical characterizations. (d) Scalable integration of fully printed graphene-based MSCs.