Flexible and Integrated Micro-Supercapacitors Based on Graphene and 2D Materials

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Abstract

Micro-supercapacitors (MSCs) are important on-chip micro-power sources for miniaturized integrated electronics. Using graphene and 2D materials, new designs for thin-film planar MSCs with outstanding performance have become possible, taking full advantage of their atomic layer thicknesses and flat morphology. Here I will present our recent advances on the reasonable fabrication and construction of high-performance MSCs based on graphene and 2D materials. First, we demonstrate graphene-based flexible and high-power MSCs through micropatterning of methane-plasma or photochemically reduced graphene films, allowing for operations at ultrahigh rate up to 2000 V s^{-1}. Second, we describe large-area, highly uniform, ultrathin, heteroatom (N, B, S)-doped graphene films for MSCs, providing enhanced volumetric capacitance of 400~600 F cm^{-3}. Third, we show the universal construction of graphene compact films (polyaniline/polypyrrole nanosheets, thiophene nanosheets, phosphorene, MnO_2 nanosheets) for high-energy MSCs, up to 46 mWh cm^{-3}. Finally, sandwich-like planar MSCs with symmetric and asymmetric configuration as well paper based linear tandem MSCs will be presented. Therefore, these MSCs have great promise as micropower sources for direct integration of future portable, wearable, and implantable microelectronics.

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Figures

Figure 1: Graphene based interdigital planar MSCs (left) and arbitrary-shape sandwich planar MSCs (right)