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# Graphene quantum dots as a novel conductive additive to improve the capacitive performance for supercapacitors

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## Abstract

Graphene quantum dots (GQDs) as a novel conductive agent with nanometer-scale instead of the common carbon black (CB) offer a promising route to construct an effective conductive network for the improvement of the supercapacitors' capacitive performance. Interestingly, the electrochemical performance of activated carbon (AC)-based composite electrodes with different amounts of GQDs in two composite ways was tested, which showed the extremely apparent correlation between the electrode structure and the capacitive characteristics. It was found that the specific capacitance ( $C_m$ ) and rate performance were enhanced when GQDs at an appropriate weight ratio (1 wt%) in the electrode material, compared with 10 wt% CB, and the corresponding  $C_m$  values are 110 and 100 F g<sup>-1</sup> at a current density of 0.1 A g<sup>-1</sup> and 85 and 65 F g<sup>-1</sup> at 1 A g<sup>-1</sup>, respectively. Furthermore, composite electrodes by heating treatment displayed the better electronic conductivity and cycling stability, which was caused by removing oxygen functional groups, at the expense of decline for the ionic conductivity and rate performance. This work demonstrates an effective method to

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