Electrochemical Exfoliation and Functionalisation of 2D-materials for Energy Storage Devices

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Electrochemical exfoliation of graphite is considered to be a fast, scalable and eco-friendly way for produce graphene.[1, 2] Cathodic exfoliation in organic electrolyte, unlike anodic exfoliation, produces high quality graphene as it eliminates the formation of oxygen containing functional groups.[2] However, development of application in graphene is currently hampered by its poor dispersion in common, low-boiling point, solvents. In this contribution, we describe the single step simultaneous electrochemical exfoliation and functionalisation of graphene using diazonium compounds.[3] Using caesium salt (dissolved in dimethyl sulfoxide) as the intercalating ions in combination with diazonium salt (either 4-nitrobenzenediazoniumtetrafluoroborate, 4 bromobenzenediazonium tetrafluoroborate or anthraquinone-1-diazonium chloride) as functionalisation moieties were used. We found that the presence of diazonium compound in solution not only acts to functionalise the graphene but also aids the exfoliation through the generation of N_2 gas which assists the separation of the functionalised graphene layers. The functionalisation also enhanced the dispersibility of graphene in aqueous solution by two orders of magnitude and increased the charge storage capacity of graphene by three times because of the introduction of surface active redox reactions (Figure 1). Finally, we will introduce the improved capacitive performance of graphene and MoS_2 nanocomposite.

References

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[3] D. W. Johnson, B. P. Dobson and K. S. Coleman, *Current Opinion in Colloid & Interface Science*, 2015, **20**, 367-382.

Figures

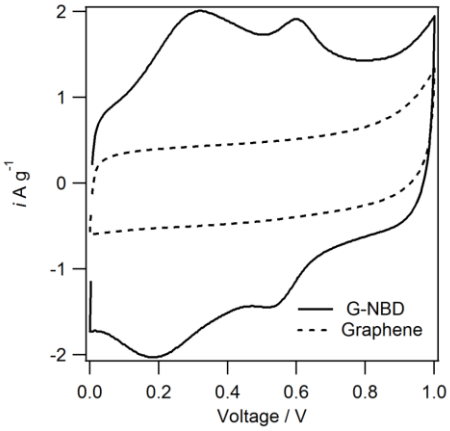

Figure 1: Cyclic voltammograms recorded at 100 mV s^{-1} in 6.0 M KOH (aq) using symmetrical coin cells constructed from electrochemical exfoliated restacked graphene and graphene functionalised insitu with 4-nitrobenzenediazoniumtetrafluoroborate (G-NBD). The voltage was swept between 0.0 V to 1.0 V