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Capacitive performance of cysteamine functionalized carbon nanotubes

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HIGHLIGHTS

- 4-times capacitance enhancement by functionalizing MWCNTs with cysteamine groups.
- Oxidation of thiol into sulfinic acid in cysteamine during functionalization.
- Redox reaction of sulfinic acid and sulfenic acid during charge discharge.
- High cycling stability (90%) of MWCNTs-Cyst.

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ABSTRACT

We report on the capacitive performance of redox active cysteamine-functionalized multi walled carbon nanotubes (MWCNTs-Cyst). The thiol functional groups are found to be oxidized into sulfinic acid groups during functionalization of MWCNTs-Cyst, rendering the functional groups act as the molecular spacer to prevent MWCNTs agglomeration and the redox active sulfinic acid groups provides pseudocapacitance effect. The specific capacitance attained on MWCNTs-Cyst is found to be approximately 4-times higher than the nonfunctionalized MWCNTs electrodes. The enhancement can be attributed to the surface area enhancement in MWCNTs-Cyst and the pseudocapacitance effect. *Ex situ* spectroscopy (XPS and FTIR) confirms pseudocapacitive behavior of sulfinic acid groups, which undergo redox reaction into sulfenic acid groups upon charging and discharging process. Impedance study reveals the charge transfer process is facilitated by the redox reaction of sulfinic acid groups, thus lowering the charge transfer resistance. Interestingly, the supercapacitor made from MWCNTs-Cyst remains highly stable (90% retention) even after long cycle of charge-discharge operation (11,000 cycles).

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