Capacitive performance of cysteamine functionalized carbon nanotubes

Gomaa A.M. Ali a, b, Ellie Yi Lih Teo a, Eslam A.A. Aboelazm a, Hamidreza Sadegh c, *, Amir O.H. Memar d, Ramin Shahryari-Ghoshekandi c, Kwok Feng Chong a, **

a Faculty of Industrial Sciences & Technology, Universiti Malaysia Pahang, Gambang, 26300, Kuantan, Malaysia
b Chemistry Department, Faculty of Science, Al–Azhar University, Assiut, 71524, Egypt
c Department of Chemistry, Science and Research Branch, Islamic Azad University, Tehran, Iran
d Young Researchers and Elite Club, Science and Research Branch, Islamic Azad University, Tehran, Iran

HIGHLIGHTS

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

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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