Vertically Aligned Carbon Nanotubes grown on Graphite Paper Electrodes for Highly Flexible Supercapacitors

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Abstract

Carbon nanotubes (CNTs) are being extensively investigated for electrochemical applications. Among the multiple techniques used to grow the CNTs for specific applications, like supercapacitor electrodes, we have precisely tuned the parameters of plasma enhanced chemical vapor deposition (PECVD) for growing vertically aligned CNTs (VACNTs), each one electrically connected to a 0.20 mm thick and highly flexible PAPYEX® graphite foil N998. Iron (Fe) thin film was used as a catalyst to grow the CNTs. Catalyst thickness, annealing temperature and PECVD time were also explored. Optimum conditions were found to be 2 nm of Fe film thickness, 750°C of annealing temperature and 15 min of PECVD process. To increase the hydrophilicity and to remove the amorphous carbon generated during the deposition of the CNTs, samples were treated by O_2 plasma. Raman spectra showed that the CNTs become more crystallyne after functionalization with O_2 plasma (Figure 1). Electrochemical characterization was carried out for the obtained CNTs. MnO_2 nanoparticles were deposited on the CNTs (Figure 2) to increase the areal capacitance from 22.5 mF/cm^2 to 40.2 mF/cm^2 at a scan rate of 10 mV·s^{-1}.

References

[1] Yiran Yan *et al.*, Carbon, 142 (2019) 238-244.
[2] Serkan Akbulut *et al.*, Diamond & Related Materials, 74 (2017) 222-228.
[3] M. S. Dresselhaus *et al.*, Physics Reports, 409 (2005) 47-99.

Figures

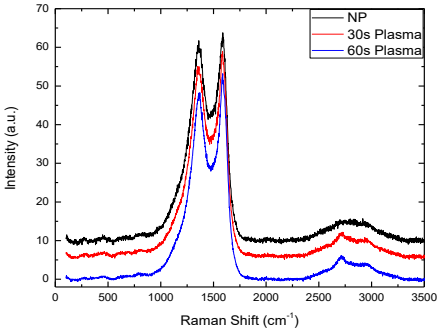

Figure 1: Raman specta of CNTs over graphite paper before and after O_2 functionalization.

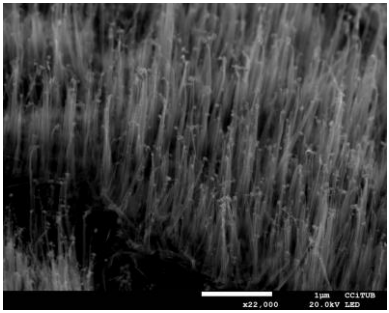

Figure 2: SEM image of VACNTs over graphite paper.