Designing of MWCNT Bucky Paper Reinforced PANI-DBSA-DVB Composites for Superior Electrical and Mechanical Properties

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Figure S1 FT-IR analysis of neat PDD and MWCNT-PDD matrix

The interfacial interaction between MWCNT and PDD is analysed by using FT-IR measurement. In fig. 3, major peaks of neat PDD and MWCNT-PDD are compared. In the spectrum of neat PDD, peaks at 1576.9 cm⁻¹ and 1465.6 cm⁻¹ correspond to C=C symmetrical stretching of quinoid and benzenoid ring, respectively. The peaks at 811.3 cm⁻¹ and

1300.2 cm⁻¹ corresponds to out of plane (oop) band of C-H bond of 1,4-disubstituted benzene ring and C-N symmetric stretching. Also, an important binding of PANI and DBSA observed at 1020 cm⁻¹ which correspond the NH⁺ — SO₃⁻ interaction between PANI and DBSA dopant. Another significant peak in neat PDD solution is at around 1094.8 cm⁻¹ which corresponds to N=Q=N bond (where Q = quinoid ring). The peaks associated with nitrogen in PDD are affected mainly by the addition of MWCNT in it. In MWCNT-PDD, peak of N=Q=N bond shifts towards higher frequency, i.e., at 1126.4 cm⁻¹.^{1, 2} It is because of van der Waal interaction between MWCNT and PDD resulted in improved bonding. Also, the shifting of this band to 1129 cm⁻¹ is associated with a π - π interaction between MWCNT and quinoid ring which strengthen the bonding.³ Here, FTIR reveals strong evidence of chemical interaction between MWCNT and PDD system which results in an improved mechanical as well as electrical properties.





In plane electrical conductivity of bucky paper is measured by four probe technique in which two probes are used as a current source and another two are for voltage drop by using Kitheley 2602A source meter, as shown in fig. 4a. Bucky paper has a size of $20 \text{cm} \times 16 \text{cm} \times 0.015 \text{m}$ was placed in between two copper strips as shown in fig. 4b. Copper strips are connected with 10 mA dc current source and the corresponding voltage drop across the sample is measured by two 1.5 cm apart fixed probes manually. Average in plane electrical conductivity of ten bucky paper samples is measured and comes to be 25.82 ± 3.42 S/cm.



Figure S3 SEM images of bucky paper reinforced laminar composite (a) low magnification (200 X) (b) higher magnification (2000 X) and (c) bucky paper reinforced PDD matrix at (5000 X)



Figure S4 TEM images of PDD matrix coated MWCNT at (a) 39000 X, (b) 49000 X and (c) 295000 X

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