EM shielding effectiveness of PdCNTs-Cu nanocomposite buckypaper

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Supplementary Information

1. Role of palladium in the composite

Palladium has been used for activation of CNTs in the form of Pd^{2+} using acidic solution of $PdCl_2$ and very small amount of $SnCl_2$ for reduction of Pd^{2+} into Pd^0 state at the time of activation as shown in equation I and II, [1, 2], which absorbed by surface of the CNTs. A small amount of $SnCl_2$ is helpful in the selective area decoration of Cu on CNTs. The following reactions take place during the activation.

$$Sn^{2+} \longrightarrow Sn^{4+} + 2e^- \text{ ----------(I)}$$

$$Pd^{2+} + 2e^- \longrightarrow Pd^0 \text{ ----------(II)}$$

2. Elemental analysis of the PdCNTs

Fig-1S(A-C) shows the quantitative elemental analysis of PdCNTs using EDS with elemental mapping , which clearly shows the signature of Pd in PdCNTs, although it shows the presence of Pd in very small amount as the concentration of Pd (0.005g in 1g CNTs) is used for the synthesis of the PdCNTs.

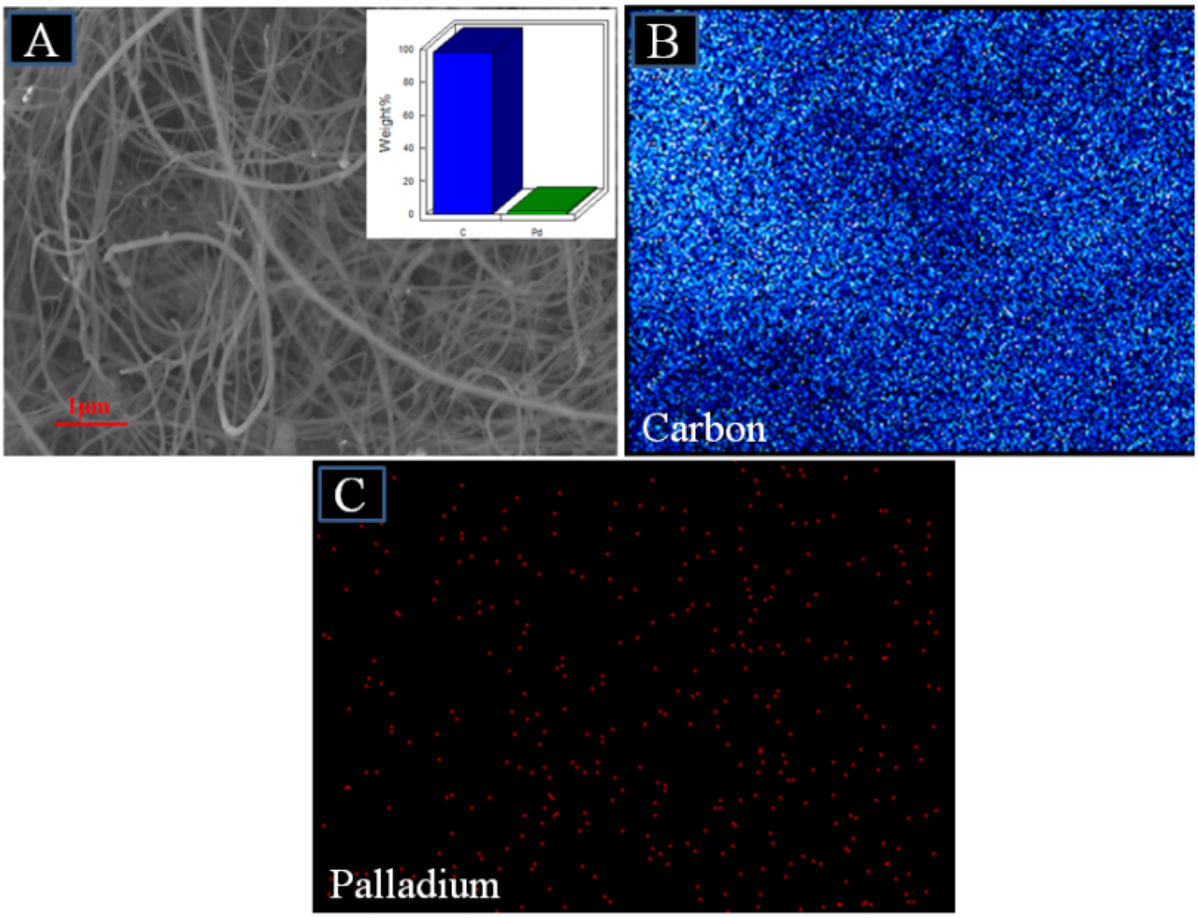

Fig. 1S (A) FESEM image of PdCNTs. Inset shows the weight % ratio of C and Pd, (B) Elemental distribution mapping using EDS of C and (C) Elemental distribution mapping using EDS of Pd in the PdCNTs

3. Elemental analysis of the Cu_{15}PdCNTs

Fig. 2S (A-C) confirm the presence of the Cu in the composite using EDS analysis by making a point on agglomeration of Cu-CNTs. Further, elemental mapping (Fig 2S (A)) has been carried out on a bunch of Cu decorated CNTs in the nanocomposite as shown in Fig 2S (B and C). This has revealed that the presence of Pd was not detected in the Cu nanocomposite may be due to the small amount of the Pd has been used in the synthesis (0.005g in 1g CNTs) and has also been

reported earlier [3]. Fig. 2S(D) shows the Thermogravimetric analysis for the Cu_{15}PdCNTS in air and nitrogen, which confirmed the amount of Cu present in the composite about ~15 Wt%.

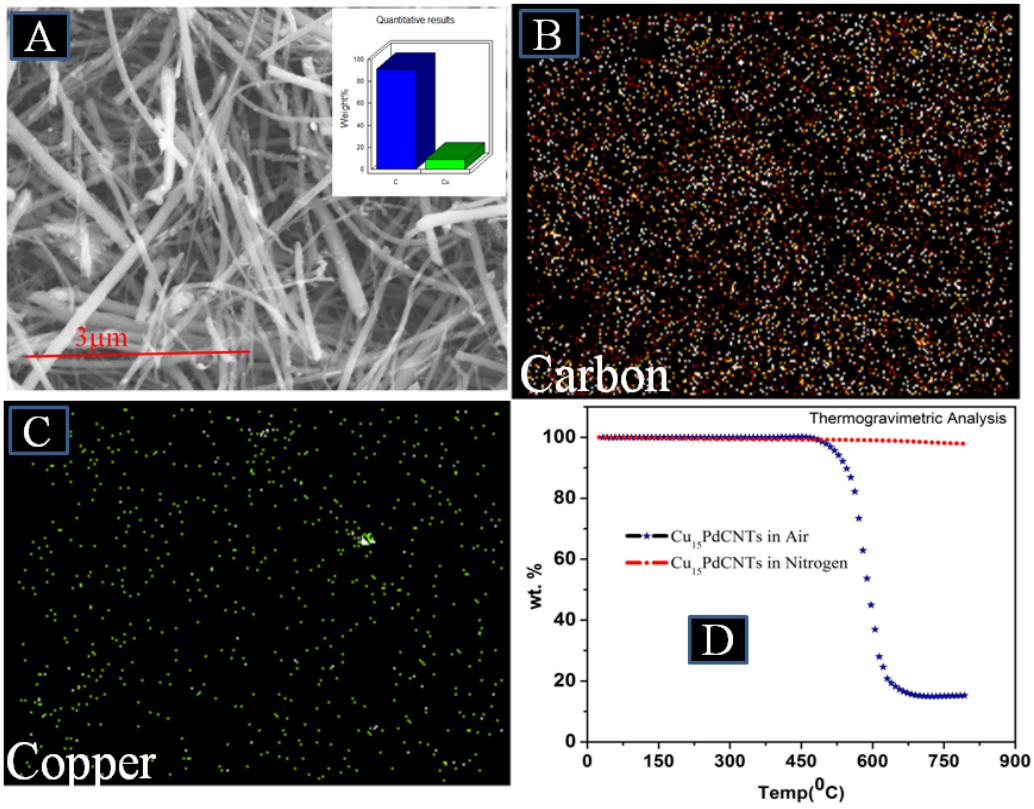

Fig. 2S (A) FESEM image of Cu_{15}PdCNTs composite and Inset is a weight % ratio of C and Cu, (B) Elemental distribution mapping using EDS of C in the composite, (C) Elemental distribution mapping using EDS of Cu in the composite, and (D) Thermogravimetric analysis of Cu15PdCNTs in nitrogen and air

4 .FESEM of carbon buckypaper:

Fig-3S (A) and (B) show a typical micrograph using FESEM of Cu decorated carbon nanotubes buckypaper (Cu5PdCNTs) synthesized by electroless technique at low and high magnification, respectively. A random arrangement of CNTs is evident with entangled CNTs with each other.

Presence of Cu nanoparticles on CNTs can clearly be seen on the CNTs surface in the composite.

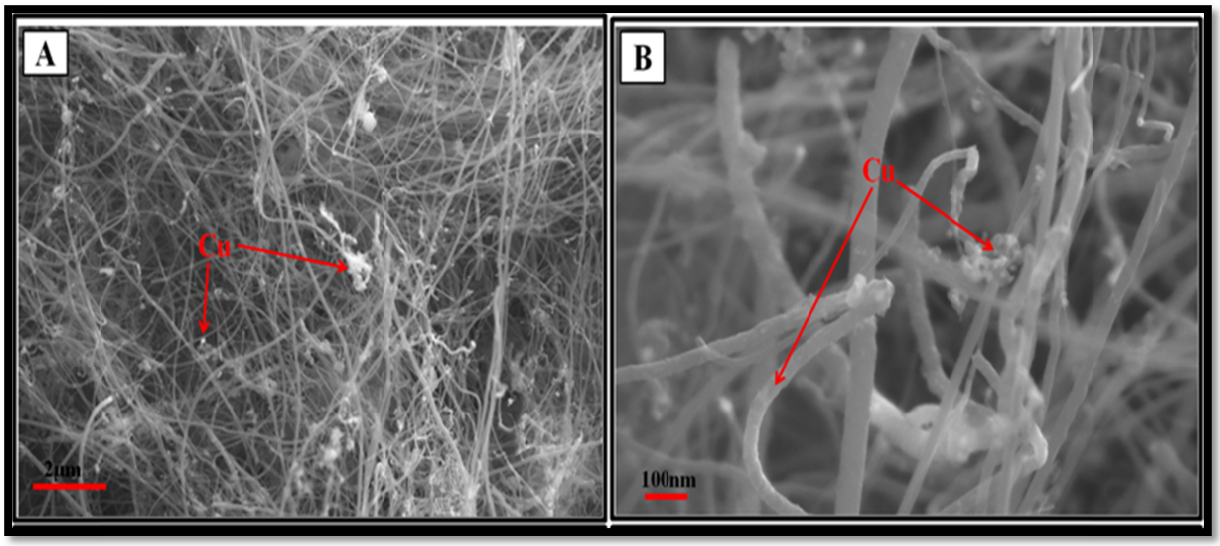

Fig: 3S: FESEM images of batch Cu_{15}PdCNTs at low (A) and high (B) magnification

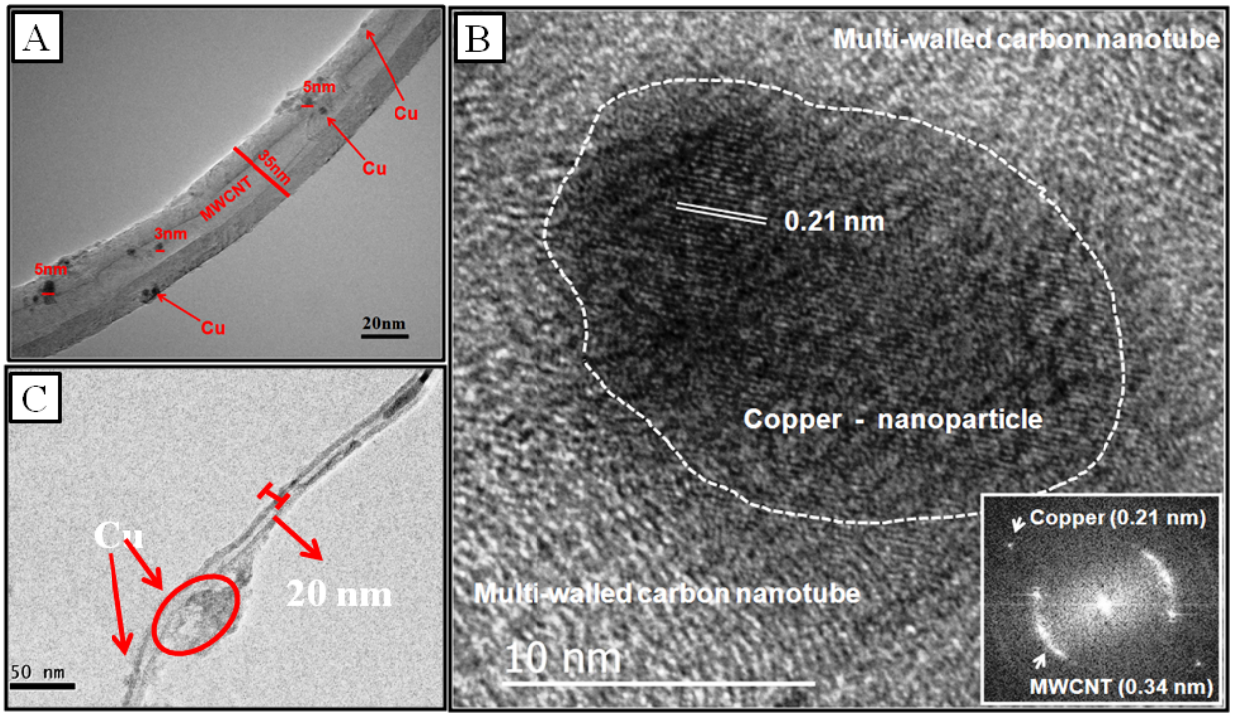

Fig: 4S: (A) microstructure of $Cu_5PdCNTs$ nanocomposite showing the carbon nanotubes along with the presence of Cu nanoparticles (B) The atomic scale image of a Cu nanoparticle with interplanar spacing of 0.21 nm circumference with walls of a CNT. Inset shows a FFT of MWCNT and Cu; and (C) microstructure of $Cu_{25}PdCNTs$ nanocomposite showing the agglomeration of Cu nanoparticles

5. EMI shielding effectiveness of the MWCNTs buckypaper

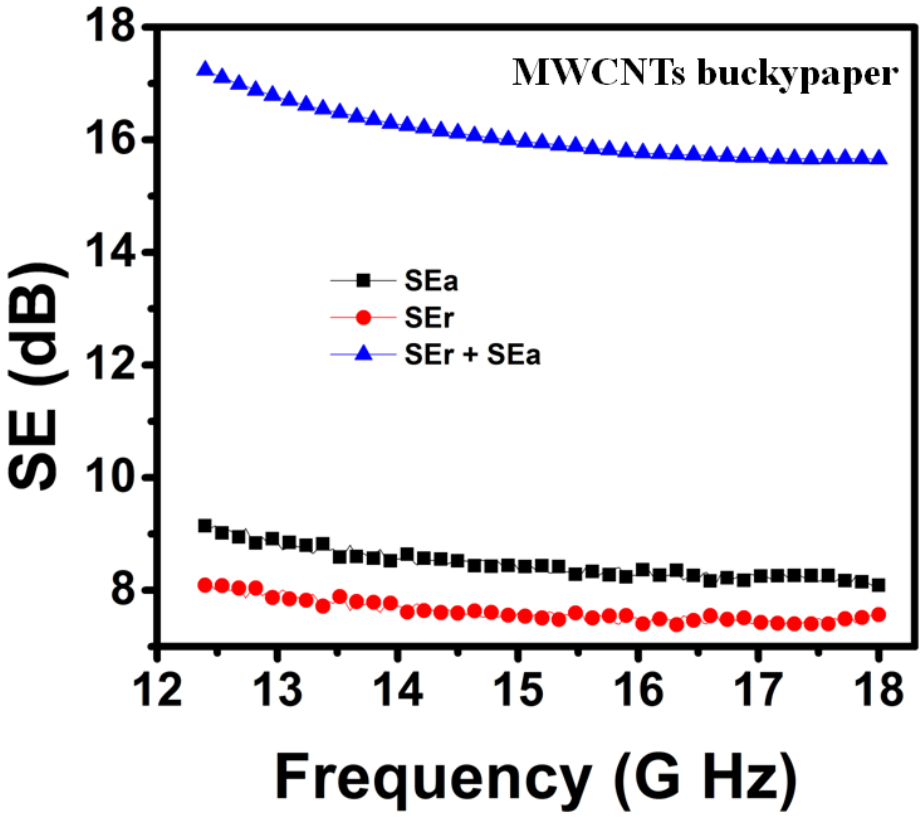

Fig: 5S: Frequency dependent EMI shielding of MWCNTs buckypaper total, absorption and reflection at 200µm thick sample

References:

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2. L. M. Ang, T. S. A. Hor, G. Q. Xu, C. H. Tung, S. P. Zhao and J. L. S. Wang, *Carbon*, 2000, **38**, 363-372.
3. J. Ahn, D. Kim, J. Lee, H. Chung, C. Kim and H. Hai, *Surface and Coatings Technology*, 2006, **201**, 3793-3796.