Multi-walled carbon nanotube-graphene-polyaniline multiphase nanocomposite with superior electromagnetic shielding effectiveness

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Raman spectra of graphite in figure S1 show a characteristic peak of carbon at 1580 cm-1 and 1300 cm-1. It is reported that as the number of layers increases, the intensity of G band increases significantly while that of the 2D band decreases. The G band is more intense than the 2D band. The 2D band has a two peak profile, the intense 2D1 band and a low energy shoulder called the 2D2 band (in figure, right inset). This splitting is due to the splitting of π electron dispersion caused by interaction between the neighboring graphitic planes. The position of 2D band depends on the number of layers and stacking order of the graphitic samples. Any modification of the graphitic surface is clearly identifiable via the 2D2 band.

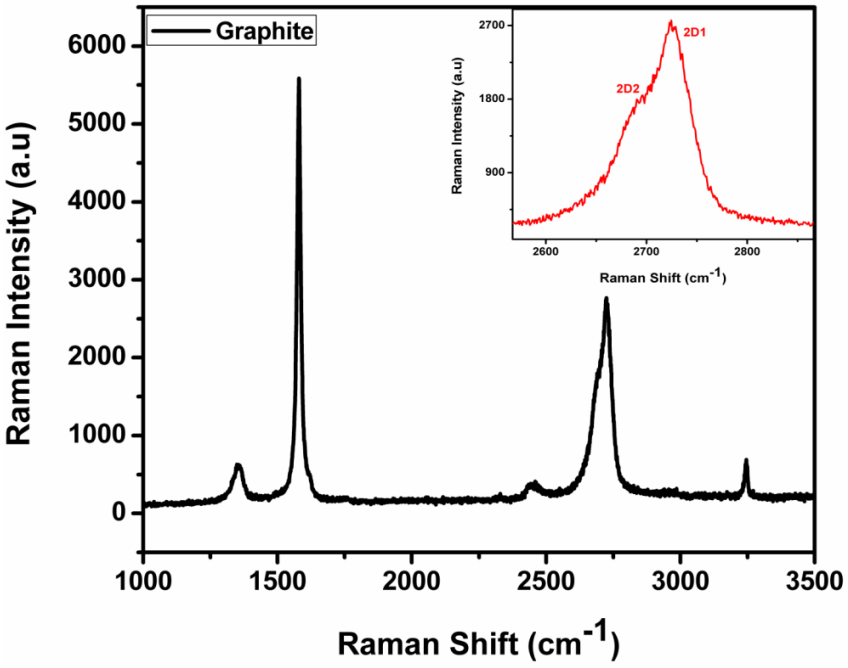

Figure S1. Raman spectra of Graphite (2D1 and 2D2 band in Inset)

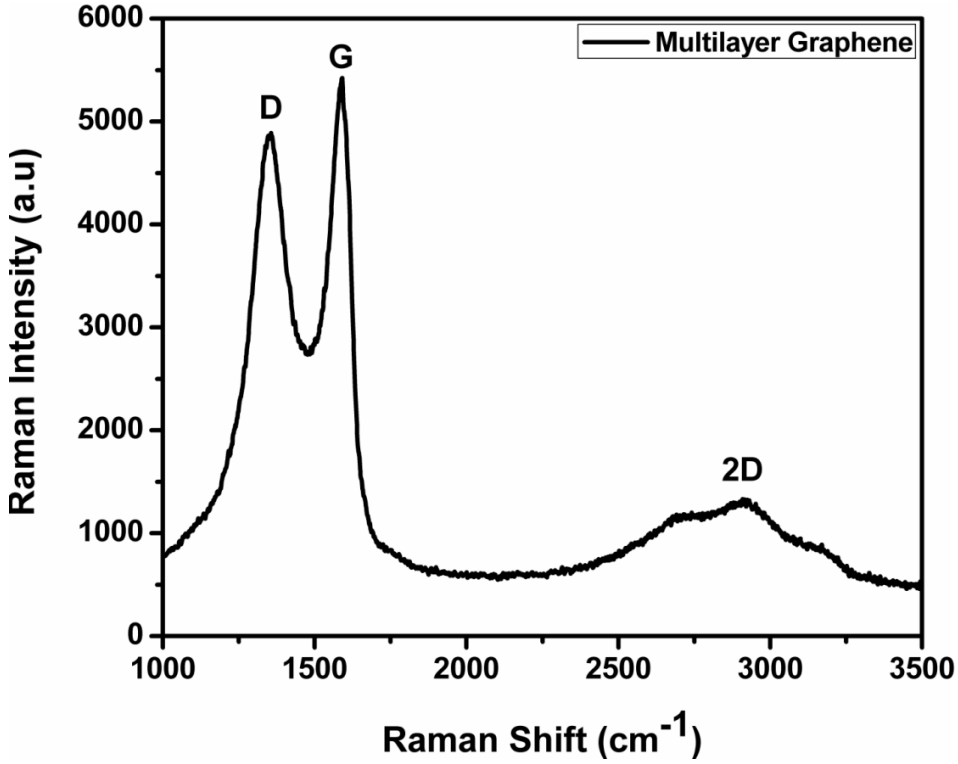

Figure S2. Raman spectra of multilayer graphene

Figure S2 shows Raman spectra of multilayer graphene include G band and D band at 1588 cm-1 and 1350 cm-1 respectively. The 2D band is a characteristic band, represents number of layers in graphene. A sharp peak at 2700 cm-1 (2D region) represents a single layer graphene. While a modulated bump shows few layer graphene.

So a significant change occurs in the shape and intensity of the 2D peak of graphene compared to bulk graphite. The 2D peak in bulk graphite consists of two components 2D1 and 2D2. While Graphene have a single, sharp 2D peak in case of single Layer graphene (four times more intense than the G peak) and a bump in few layer graphene. As we can see in the figure 2 that there is a modulated bump at 2D band position (2700 cm^{-1}) and no 2D1 and 2D2 peak were found in region of 2D band which refers the presence of multilayer graphene in the material.

The total shielding effectiveness values for multiphase nanocomposites with 10 and 12 wt.% of MWCNTs are compared in figure S3. Both the curves of shielding effectiveness are same and overlapped on each other, even though at higher content of MWCNTs there is no further increase

in the value of shielding. This might be due to agglomeration of MWCNTs in PANINGF-MWCNTs composites.

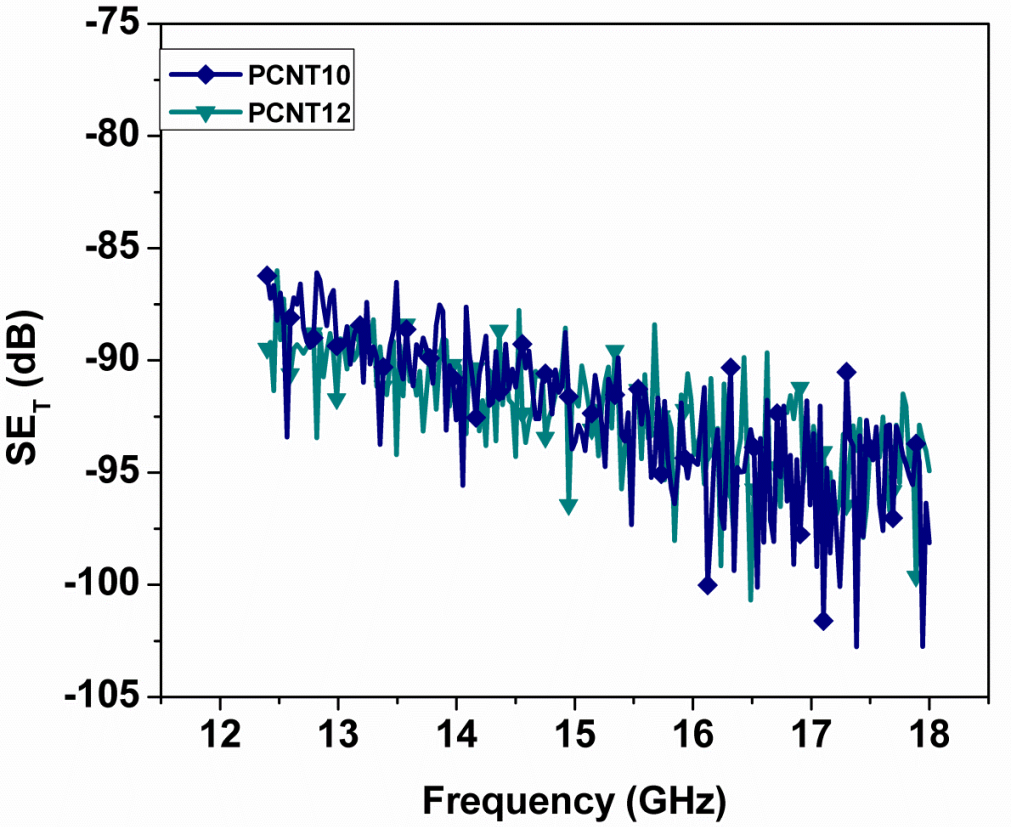

Figure S3. SE_T of PCNT10 and PCNT12