Supporting Results

1. TGA Analysis:

To substantiate potential of these nanocomposites in high temperature applications it becomes necessary to study thermal properties, so thermal stability of these nanocomposites was studied by recording thermogravimetric analysis (TGA) scans. Thermo-gravimetric analysis (TGA) was carried out on thermal analyzer (TGA-Netzsch) using alumina as the reference material from room temperature to 600 ºC with heating rate of 10 ºC/min under nitrogen purging with flow rate of 50 mL/min. TGA curves of neat epoxy and different types of nano-filler (TiO_2, GP and TiO_2+GP) are shown in Fig. 1. The thermal degradation of all materials has been taken between 150-600 ºC and the neat epoxy started to degrade at 300 ºC. From the TGA curves it is clear that the thermal stability of nanofiller reinforced epoxy nanocomposites is greater than neat epoxy. The epoxy nanocomposite with TiO_2 (0.25 wt.%)+GP (0.25 wt.%) shows maximum thermally stability as compared to others. Initial 5 % weight loss of materials is important for its load bearing applications. The 5% weight loss temperature for TiO_2 (0.25 wt.%)+GP (0.25 wt.%) reinforced epoxy nanocomposite found to be maximum i.e 333 ºC and for neat epoxy it was 323 ºC. From the Fig. 1, it shows that the char yield percentage of TiO_2 (0.25 wt.%)+GP (0.25 wt.%) reinforced epoxy nanocomposite shows maximum char residue i.e 28 % as compared to neat epoxy with char residue 22%.

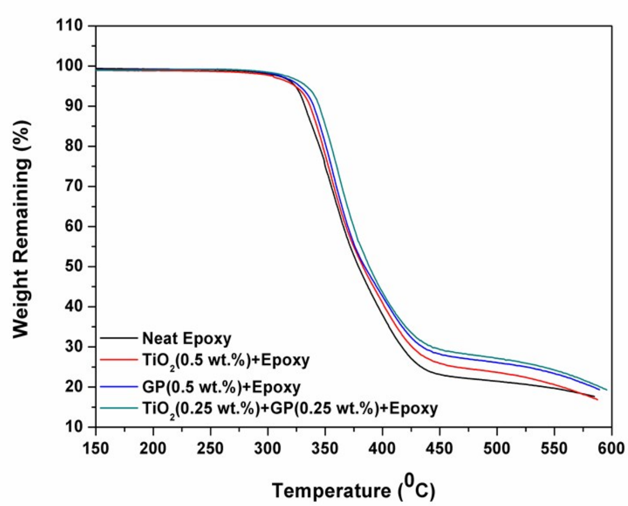

Fig. 1 TGA graph of TiO_2, Graphene (GP) and TiO_2+GP reinforced epoxy nanocomposite

2. FTIR Analysis:

FT-IR analysis of the neat epoxy and nanocomposites were carried out using their fine powder with KBr on Perkin Elmer spectrometer from 500 to 4000 cm^{-1} wave number. Fig. 2 shows the FTIR spectra of neat epoxy and its nanocomposites. All FTIR spectra have many common signals and no significant change in peaks was observed with the reinforcement of graphene and TiO_2 nanoparticles. The first one is the broad peak around 3500–4000 $cm^{-1.}$ It is corresponding to O–H stretching vibrations from C–OH groups and absorbed water molecules.[55] The signals from 2965 to 2873 cm^{-1} arise due to C–H stretching of CH_2 and CH aromatic and aliphatic. The absorptions at 1608, 1509, 1452, 1368, 1089, 1036 and 772 cm^{-1} are attributed to the C=C of aromatic ring, C–C of aromatic, C–H of CH_2 and CH_3, CH_3 of –$C(CH_3)_2$, C–O bonds, C–O–C of ethers and CH_2 rocking respectively of epoxy chain and graphene.[1-2] The characteristic signal at ∼520 cm^{-1} from stretching vibration of the O-Ti-O lattice of TiO_2 nanoparticles are overlapped by epoxy absorption band in range 500 to 600 cm^{-1}.[3]

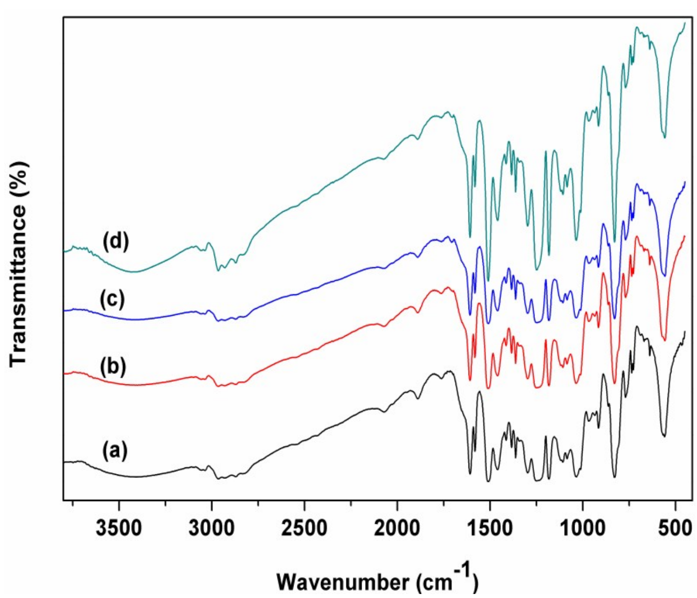

Fig. 2 FTIR spectra of (a) neat epoxy, (b) TiO_2-epoxy, (c) graphene-epoxy and (d) graphene/TiO_2-epoxy nanocomposite

References:

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