Synthesis of nano Carbon - Fe3O4 based polymer composites for EMI shielding applications

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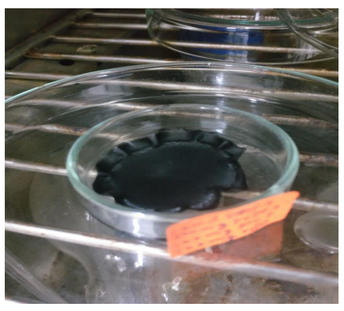
INTRODUCTION

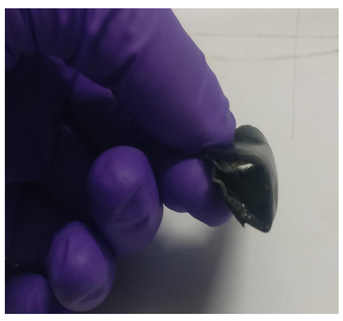
The present work is focused on the study of nanocomposites consisting of Fe_3O_4 nanoparticles, Mesoporous Carbon (MC) and reduced graphene oxide (rGO) as nanofillers in non-conducting polymer (Polyvinylidene difluoride (PVDF)) matrix for Electromagnetic Interference (EMI) shielding applications. PVDF polymer nanocomposites have been prepared using solution casting process by changing loading percentage of fillers and these composites are carefully characterized. The dielectric, magnetic, conducting, thermal, mechanical and wettability properties are studied using various tools. Field Emission Scanning Electron Microscopy (FESEM) show particle size in range of 30 nm- 50 nm; Energy Dispersive X-ray spectroscopy (EDAX) confirm the presence of Fe_3O_4, rGO and MC with different percentage, Fourier Transform Infra-Red (FTIR) showing the probable conjugation of MC with rGO through carboxylic bond and with Fe_3O_4 by weak hydrogen bonding, respectively with PVDF polymer. Thermo gravimetric analysis (TGA) confirms the thermal stability of the composites and EMI shielding effectiveness show 24 dB loss per (g/cm3). Promising platform using mesoporous based materials for high performance coatings, is hence demonstrated through this presentation.

Keywords: EMI shielding, Mesoporous carbon, rGO, Fe_3O_4, absorption, electrical composite etc.

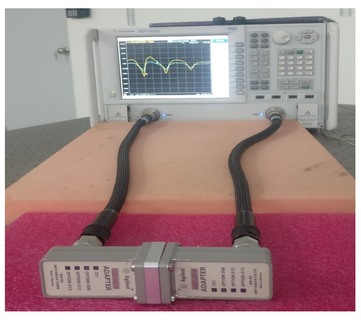
EXPERIMENTAL



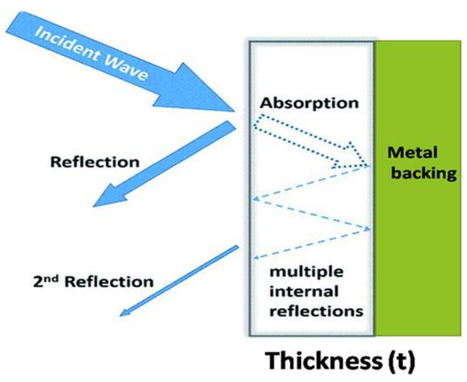
PVDF-nanocomposite film



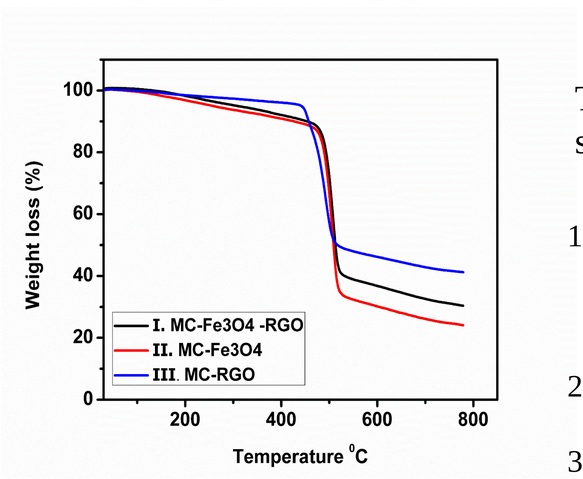
Flexibility of Film



Vector Network Analyzer



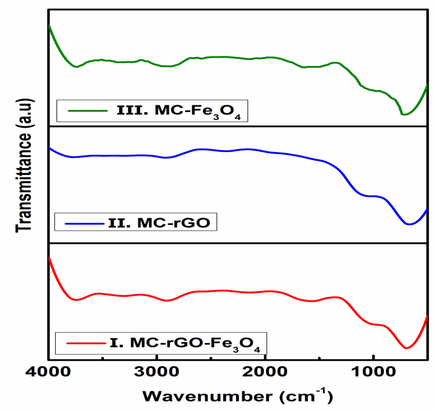
RESULTS



TGA data of MC-Fe3O4 , MC-Fe3O4-rGO, MC-rGO

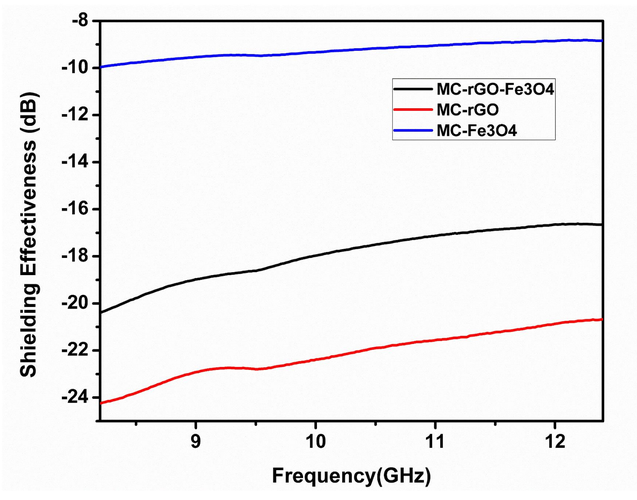
TGA used to evaluate the thermal stability of a nanocomposite.

1. At 500 C all three nanocomposite of PVDF with rGO and Fe_3O_4 showing weight loss which is basically attributed to PVDF polymer.
2. MC-rGO >MC-rGO-Fe_3O_4 > MC-Fe_3O_4.
3. We observed two step degradation in case of nanocomposites.



FTIR data of MC-Fe3O4 , MC-Fe3O4-rGO, MC-rGO

1. The peaks at 2978, 1400 and 1169 cm-1 can be attributed to the stretching and deformation vibrations of C–H and the C–F stretching vibration, respectively.
2. stretching and deformation vibrations peaks of C–H and C–F in PVDF, only the peaks of C=O stretching vibration and C=C skeletal stretching vibration of rGO.
3. MC probable conjugates with PVDF through weak hydrogen bonding.
4. FTIR analysis, it can be concluded that the MC-rGO- Fe_3O_4 get incorporated in the PVDF matrix, rather uniformly..



EMI Shielding effectiveness of of MC-Fe3O4 , MC-Fe3O4-rGO, MC-rGO

EMI shielding studies of composite in the X-band (8.2 GHz -12.4 GHz).

Nanocomposite	thickness	Shielding effectiveness (dB)
MC-Fe_3O_4	0.25 mm	10
MC-Fe_3O_4-rGO	0.25 mm	20
MC-rGO	0.25 mm	24

CONCLUSIONS

1. PVDF- Filler Composite films 0.25 mm thick, flexible, self-standing films of MC loaded with rGO and Fe_3O_4 have been studied for their reflection and absorption properties in the typical X-band of electromagnetic spectrum.
2. Nanocomposite showing thermal stability in order of MC-rGO >MC-rGO-Fe3O4 > MC-Fe3O4.
3. FTIR study reveal that probable conjugation of MC with rGO through carboxylic bond and with Fe3O4 by weak hydrogen bonding.

REFERENCES

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