In the name of God

IUST

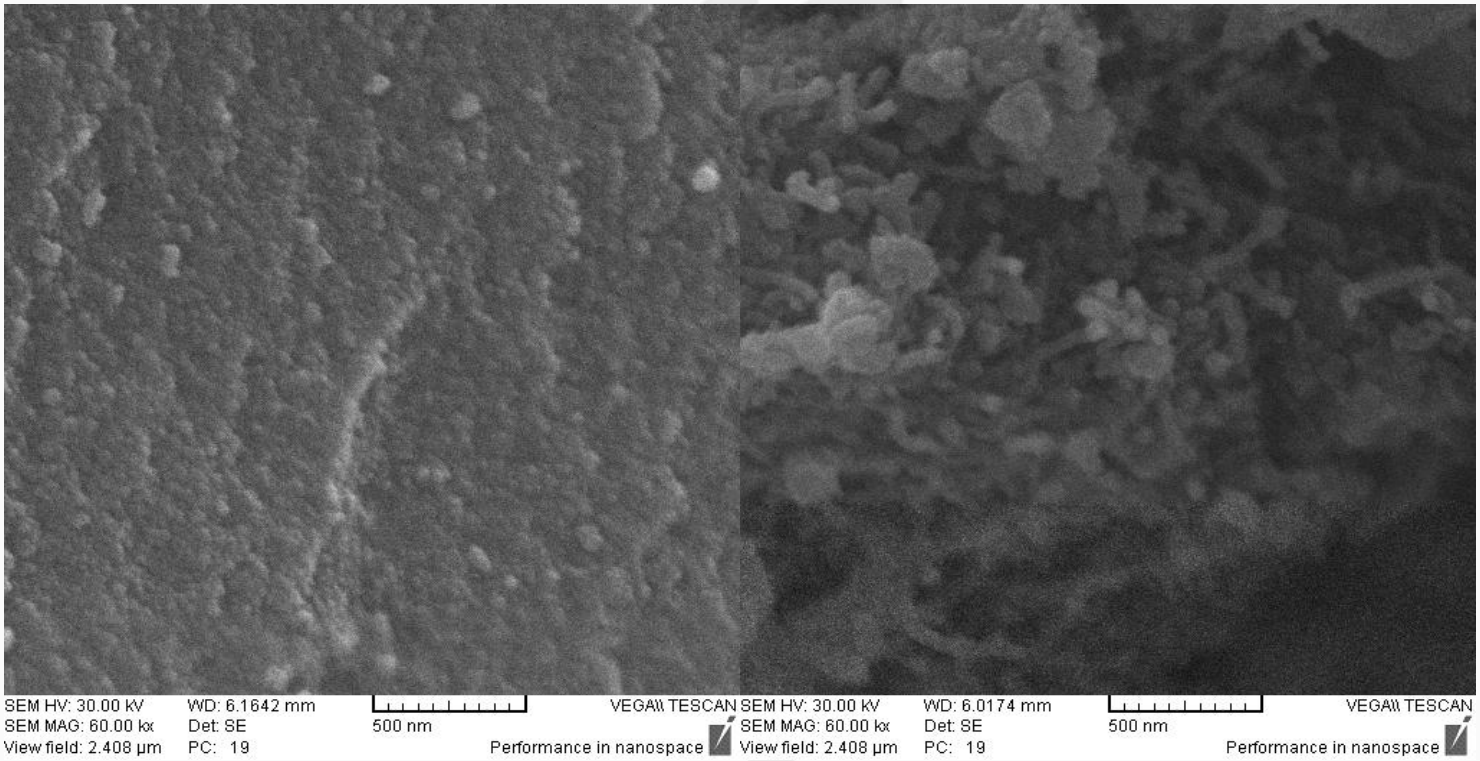

Welcome

Title:

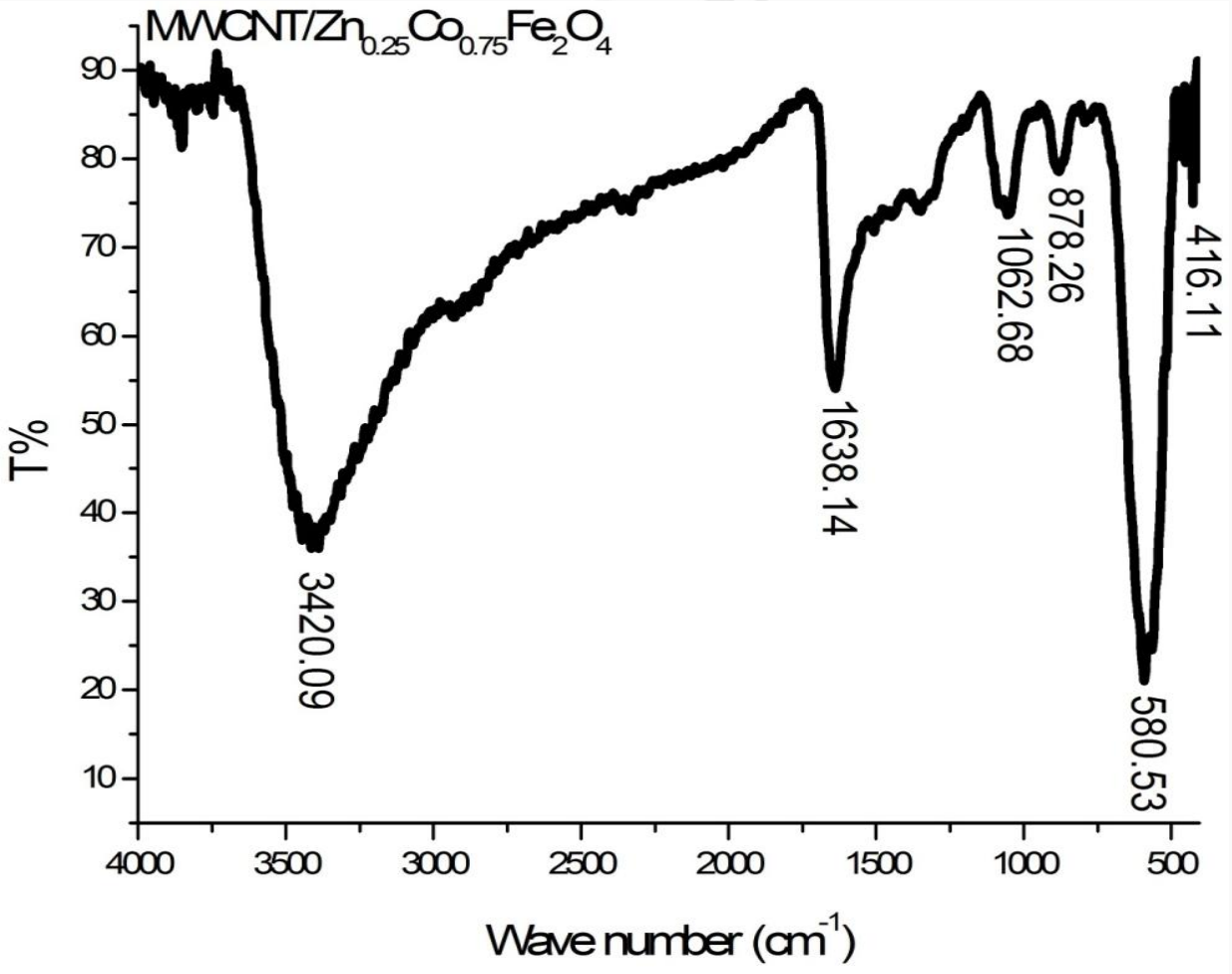
Preparation and characterization of MWCNT/$Zn_{0.25}Co_{0.75}Fe_2O_4$ nanocomposite and investigation of its microwave absorption properties at x-band by silicone rubber polymeric matrix

Microwave absorption has attracted a considerable attention in the last decade. Various factors have effect on the microwave attenuation such as permittivity and permeability of absorbers. In this research, these properties were provided by multiwall carbon nanotube (MWCNT) as a conductive polymer and $Zn_{0.25}Co_{0.75}Fe_2O_4$ as a magnetic nanoparticle. MWCNTs were functionalized with carboxylic acid groups through the sonochemical method by the mixture of nitric and sulfuric acid, due to their better dispersion in the medium reaction and enhancing interfacial polarization, and then magnetic nanoparticles were formed base on the functionalized MWCNTs through the sonochemical and solvothermal complementary methods by use of ethylene glycol as a solvent. Finally, MWCNT/$Zn_{0.25}Co_{0.75}Fe_2O_4$ nanocomposite was blended in the silicone rubber as a polymeric matrix to investigation of microwave absorption properties. $Zn_{0.25}Co_{0.75}Fe_2O_4$ nanoparticles and MWCNT/$Zn_{0.25}Co_{0.75}Fe_2O_4$ nanocomposite were identified by the diffuse reflection spectroscopy (DRS), Fourier transform infrared (FT-IR), scanning electron microscopy (SEM), and investigation of microwave absorption properties was performed by vector network analyzer (VNA). Results indicated that magnetic nanoparticles and magnetic and dielectric MWCNT/$Zn_{0.25}Co_{0.75}Fe_2O_4$ nanocomposite have been prepared and absorbed more than 47% of microwave at x-band. Moreover, maximum reflection loss of this nanocomposite was 15 dB at 11.96 GHz.

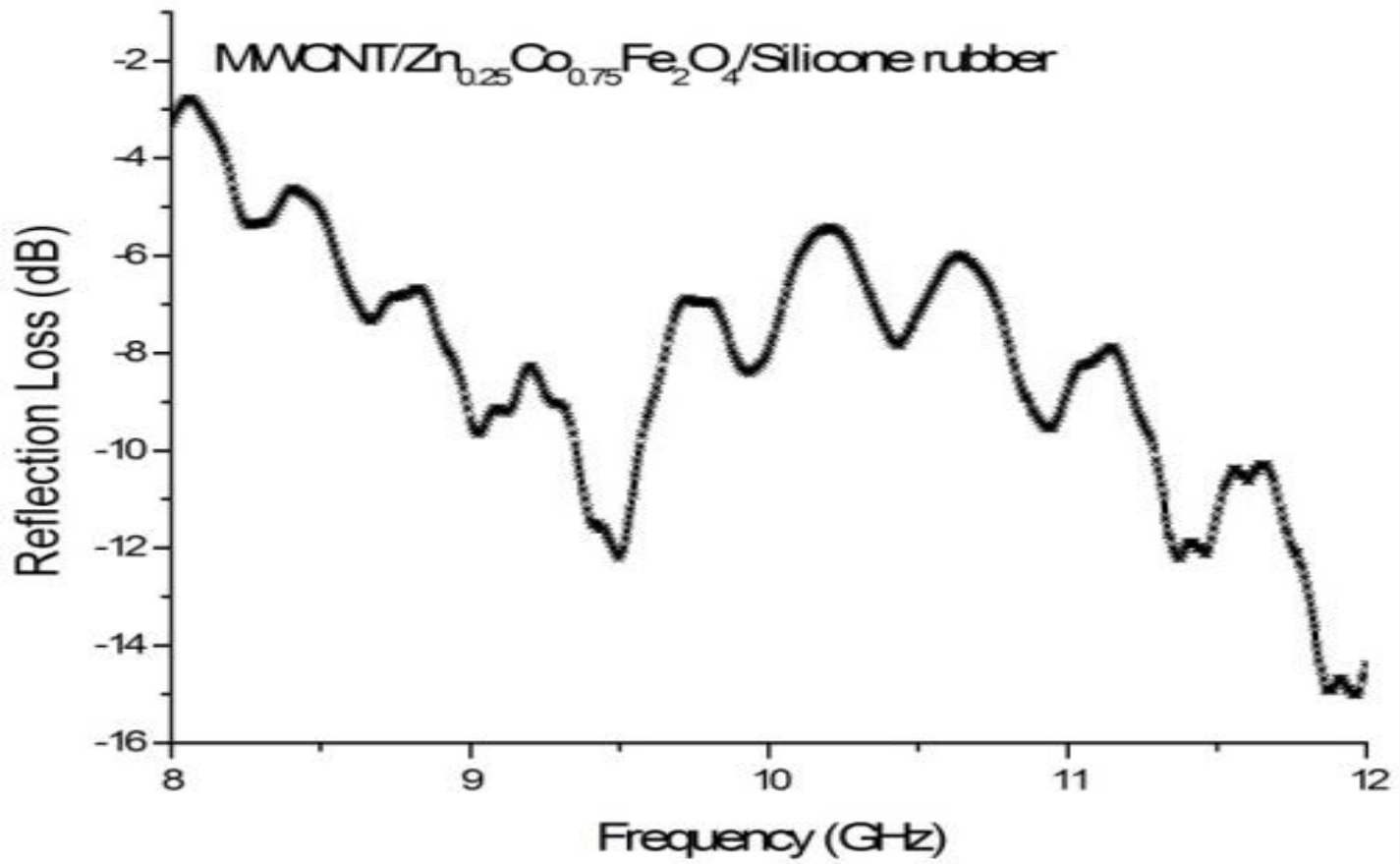
Investigation of morphology



Identification of chemical functional groups



Microwave absorption properties



Conclusion

Results indicated that MWCNT/$Zn_{0.25}Co_{0.75}Fe_2O_4$ nanocomposite was prepared through the sonochemical and solvorthermal complementary methods by use of ethylene glycol as a solvent. FT-IR spectroscopy showed MWCNTs were fuctionalized by the acidic treatment and metal oxides formed base on the MWCNTs and MWCNTs structure was maintained after sonochemical and solvorthermal treatments. Uniform structure of magnetic nanoparticles and homogenous coat of MWCNTs by nanoparticles was confirmed by SEM images. Finally, VNA result showed that MWCNT/$Zn_{0.25}Co_{0.75}Fe_2O_4$/silicone rubber nanocomposite have a substantial microwave absortion properties. This research introduced a promising complementary method to preparation of nanocomposites and microwave absorbing nanomaterials.

References

- [1] R. Peymanfar, S. Javanshir, Preparation and characterization of Ba 0.2 Sr 0.2 La 0.6 MnO 3 nanoparticles and investigation of size & shape effect on microwave absorption, Journal of Magnetism and Magnetic Materials, 432 (2017) 444-449.
- [2] R. Peymanfar, A. Javidan, S. Javanshir, Preparation and investigation of structural, magnetic, and microwave absorption properties of aluminum-doped strontium ferrite/MWCNT/polyaniline nanocomposite at KU-band frequency, Journal of Applied Polymer Science, 134 (2017).
- [3] S.S.S. Afghahi, R. Peymanfar, S. Javanshir, Y. Atassi, M. Jafarian, Synthesis, characterization and microwave characteristics of ternary nanocomposite of MWCNTs/doped Sr-hexaferrite/PANI, Journal of Magnetism and Magnetic Materials, 423 (2017) 152-157.
- [4] X.-J. Zhang, G.-S. Wang, W.-Q. Cao, Y.-Z. Wei, J.-F. Liang, L. Guo, M.-S. Cao, Enhanced microwave absorption property of reduced graphene oxide (RGO)-MnFe2O4 nanocomposites and polyvinylidene fluoride, ACS applied materials & interfaces, 6 (2014) 7471-7478.
- [5] C. Tian, Y. Du, P. Xu, R. Qiang, Y. Wang, D. Ding, J. Xue, J. Ma, H. Zhao, X. Han, Constructing Uniform Core–Shell PPy@ PANI Composites with Tunable Shell Thickness toward Enhancement in Microwave Absorption, ACS applied materials & interfaces, 7 (2015) 20090-20099.
- [6] Y.-F. Pan, G.-S. Wang, L. Liu, L. Guo, S.-H. Yu, Binary synergistic enhancement of dielectric and microwave absorption properties: A composite of arm symmetrical PbS dendrites and polyvinylidene fluoride, Nano Research, 10 (2017) 284-294.
- [7] J. Zhao, J. Yu, Y. Xie, Z. Le, X. Hong, S. Ci, J. Chen, X. Qing, W. Xie, Z. Wen, Lanthanum and Neodymium Doped Barium Ferrite-TiO2/MCNTs/poly (3-methyl thiophene) Composites with Nest Structures: Preparation, Characterization and Electromagnetic Microwave Absorption Properties, Scientific reports, 6 (2016).
- [8] H. Nikmanesh, M. Moradi, G.H. Bordbar, R.S. Alam, Synthesis of multi-walled carbon nanotube/doped barium hexaferrite nanocomposites: An investigation of structural, magnetic and microwave absorption properties, Ceramics International, (2016).
- [9] X. Jian, B. Wu, Y. Wei, S.X. Dou, X. Wang, W. He, N. Mahmood, Facile Synthesis of Fe3O4/GCs Composites and Their Enhanced Microwave Absorption Properties, ACS applied materials & interfaces, 8 (2016) 6101-6109.
- [10] M. Qiao, X. Lei, Y. Ma, L. Tian, K. Su, Q. Zhang, Well-Defined Core–Shell Fe3O4@ Polypyrrole Composite Microspheres with Tunable Shell Thickness: Synthesis and Their Superior Microwave Absorption Performance in the Ku Band, Industrial & Engineering Chemistry Research, 55 (2016) 6263-6275.
- [11] Y. Li, M. Yu, P. Yang, J. Fu, Enhanced Microwave Absorption Property of Fe Nanoparticles Encapsulated within Reduced Graphene Oxide with Different Thicknesses, Industrial & Engineering Chemistry Research, 56 (2017) 8872-8879.
- [12] B. Zhang, Y. Du, P. Zhang, H. Zhao, L. Kang, X. Han, P. Xu, Microwave absorption enhancement of Fe3O4/polyaniline core/shell hybrid microspheres with controlled shell thickness, Journal of Applied Polymer Science, 130 (2013) 1909-1916.
- [13] W. She, H. Bi, Z. Wen, Q. Liu, X. Zhao, J. Zhang, R. Che, Tunable Microwave Absorption Frequency by Aspect Ratio of Hollow Polydopamine@ α-MnO2 Microspindles Studied by Electron Holography, ACS applied materials & interfaces, 8 (2016) 9782-9789.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