RESEARCH PAPER | Physics | Volume : 3 | Issue : 5 | May 2013 | ISSN - 2249-555X

Microwave absorption properties of Polyaniline-Ta_2O_5 Composites

KEYWORDS: Civilisation, disillusionment, social structure, savagery

Sharadatayi Patil	Sangshetty Kalyane
Department of Physics, Singhania University, Pacheribari Jhun jun rajestan, India	Department of Physics BKIT Bhalki, Dist: Bidar, Karnataka, India -585328

ABSTRACT *Conducting polymer Composites are required in many engineering applications, especially, for the design of microwave absorbers and microwave shielding to ensure electromagnetic compatibility and electromagnetic immunity. In this paper, we report the synthesis of conducting polymer i.e. polyaniline (PANI) and its composites. Polyaniline is prepared by oxidation of aniline and the polyaniline composites were prepared by in situ polymerization method with dispersion of Ta_2O_5. For the microwave measurements these samples were made in rectangular pellet of thickness 0.3mm using Pye-Unicam dye. The permittivity and return loss of composites in the frequency range 8-12 GHz is discussed in this paper and the maximum absorption is observed in 10 wt% Ta_2O_5 in PANI,*

I. Introduction

Microwave radiations leaves harmful effects on human body organs if exposed for a Considerable time these effects include increase in heart beats weakening of immune systems, rearrangement of proteins including DNA increasing possibility of leukemia, sterility, cataract cancer etc. therefore stringent environmental stipulations are nowadays being enforced [1]. The electromagnetic compatibility (EMC) is an essential requirement to be fulfilled by the electronic devices/systems. Electromagnetic interference (EMI) is a disturbance on electronically controlled systems for medical & industrial instruments; EMI has become a matter of crucial concern. The rapid growths in cellular phones & wireless devices have further added to problem of EMI. The common problems due to EMI are malfunctioning of devices, formation of false/ghost images, inconsistent radar signals etc. Therefore operation of cellular phones & other wireless devices are prohibited in hospitals, bank, ATM, aero planes etc. Because of these problems microwave absorbers are gaining immerse importance in controlling the wave pollution [2-5] and ensures the undisturbed functioning of the equipment in presence of internal electromagnetic waves. Appropriate microwave absorbing materials in appropriate places in electronic equipment controls the excessive self-emission of electromagnetic waves and ensures the undisturbed functioning of equipment. Achieving the EM wave conditions is referred as Electro-magnetic compatibility (EMC). Radar signature reduction is another area where these microwave absorbers are employed for effective counter measures against radar surveillance [6-10]. Microwave absorbers stick on metallic target, absorb radar microwaves and prevent them from returning back to the transmitting/receiving antenna at the radar unit. Thus defeating the detection by radar The permittivity and return loss of composites in the frequency range 8-12 GH_z is discussed in this paper and the maximum absorption is observed in 10 wt% Ta_2O_5 in PANI,

II. Experimental

Aniline was double distilled before using for the polymerization. Aniline was dissolved in 1m HCl to form aniline hydrochloride. Ta_2O_5 was added to PANI solution with vigorous stirring to keep the Tantalum Pentoxide (Ta_2O_5) suspended in the solution. To this reaction mixture, 0.1M of ammonium persulphate [$(NH_4)_2S_2O_8$], which acts as the oxidant, was added slowly with continuous stirring for 4-6 hours at 0-5O^{0}C. The precipitated powder recovered was vacuum-filtered and washed with deionizer water. Finally, the resultant precipitate was dried in an oven for 24 hours to achieve a constant weight. In the similar manner pure PANI is prepared without adding Ta_2O_5. PANI / Ta_2O_5 composites were prepared in weight percent ratio in which the concentration of Tantalum Pentoxide (10, 30 and 50wt %) was varied [11].The microwave absorption of the PANI- Ta_2O_5 composites were analyzed using S-Parameters. The scattering parameters for this assembly were measured using the (HPES 6719) vector network analyser (VNA).

III. Results and Discussions.

Figure 1 (a) & (b) shows the variation of real (ε') and imaginary (ε'') part of the permittivity at X-band frequency (8 to 12 GHz). The ε' spectra of all the sample shows multiband significant variation in the whole frequency range used in the present work. However the ε' values have decreased with the increase of frequency, and also observed that different compositions shows different dielectric constant values but 50wt% Ta_2O_5 in Polyaniline shows maximum dielectric constant and also observed that ε' value increases with the increase of Ta_2O_5 in Polyaniline, this may be due to the interfacial polarization. The ε'' spectra shows the multiband significant variation in the whole frequency range used in the present work. However the ε'' values have increased with the increase of frequency, different compositions shows different dielectric loss values but 10wt% of Ta_2O_5 in Polyaniline shows maximum dielectric loss. This may be due to lag in polarization vis a vis the applied field.

Figure 2 shows the variation of return loss spectra at X-band frequency for the composites samples 10 wt% to 50 wt% of Ta_2O_5 in polyaniline in the frequency range 8 to 12 GHz. These composite shows increase in return loss value in multiple band form as frequency increases and observed that the 10wt% of Ta_2O_5 in PANI shows maximum return loss and also observed that the return loss increases with the decrease of Ta_2O_5 in PANI this may be due to resonance. In case PANI/ Ta_2O_5 composites the return loss varies from 7dB to 22dB.

Return loss RL (in decibel, dB) is obtained by

$RL = 20 \log [(Z_{in} - Z_o) (Z_{in} + Z_o)]\ldots$

IV. CONCLUSION

In this paper microwave absorption properties (Return loss) of PANI- Ta_2O_5 composites in the X-band frequency range have been presented. Our results clearly demonstrate that conducting PANI composite with Ta_2O_5 show better return loss and observed that 10 wt% Ta_2O_5 in PANI shows maximum return loss. These composites may be used for electromagnetic compatibility (EMC) applications.

ACKNOWLEDGMENT
The authors are thankful to the Department of Electronics (School of Physics), University of Hyderabad, Hyderabad for providing microwave measurement facility.

Figures

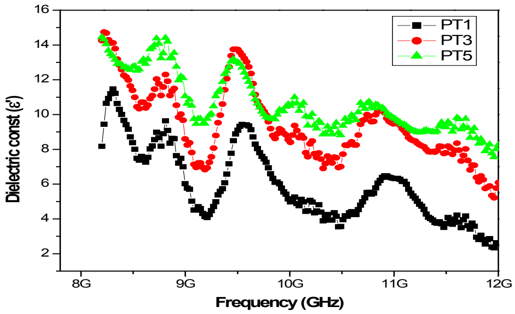

Figure 1 (a) shows the variation of Dielectric const (ε′) Vs frequency (PANI / Ta_2O_5)

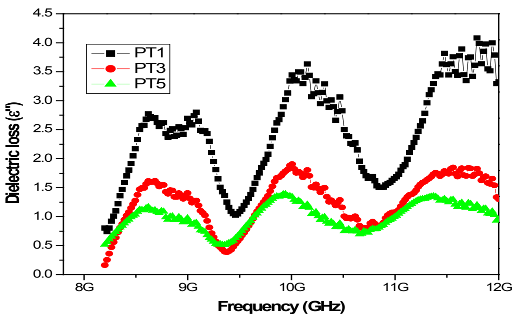

Figure 1(b) shows the variation of Dielectric loss (ε′′) Vs Frequency (PANI / Ta_2O_5)

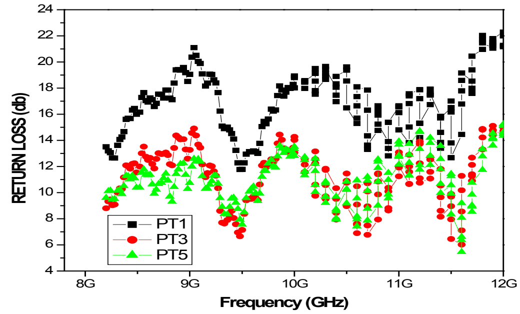

Figure 2 shows the variation of return loss Vs frequency (PANI / Ta_2O_5)

REFERENCE
[1] syed A.A. Dinesan M.K Talanta 38:815(1991) | [2] kang E.T Neoh K.L prog polym Sci 23:277(1998). | [3] Gospodinova N., Terlemezyan L., Prog Plym Sci 23:1443(1998). | [4] P. Chandrasekhar, Conducting Polymers: Fundamentals and applications, a practical Approach, Kluwer publishers, 1999. | [5] Meixiang wan, Conducting Polymers with micro or nanometer structure, Su=pringer. | [6] Xingwei Li, Wei Chen, Chaoqing Bian, Jinbo He, Ning Xu, Gi Xue, Applied surface Science, Volume 217, Issues 1-4, 15july 2003, oages 16-22. | [7] L.C Folgueras, M.A. alves, I.M Martin and M.C. Rezende "Single-and Multi-layer Microwave Absorbing Material Based on Conducting Polyaniline and Polyurethane Polymers for operation in the X-band" Proc. PIERS, Beijing, China, March 23-27, -2009,pp.301-303. | [8] A.K.M. Farid ul Islam, R. Islam, K.A. Khan and Yoshiyuki Yamamoto, Renewable Energy Volume 32, Issue 2, February 2007, pages 235-24. | [9] H. Guan, Y Zhao,S.Liu and S.Lv,Eur.Phys.J.Appl.Phys.36, 235-239(2006) | [10] suh-Cem Pang. Marc A. Anderson, and Thomas W.Chapman Journal of the Electrochemical Society, 147(2) 444-450 (200). | [11] S.C. Raghvendra, S Khasim, M Revansiddappa, M.V.N.A. Prasad, and A.B kulkarni, Bull. Mater.Sci. Vol. 26, No.7,December 2003, pp.733-739. |