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Microwave Absorption Studies on Conducting Polymer (Pani-Pbo) Composites

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Abstract: *Conducting polymers (Polyaniline) has received much attention because of its unique reversible proton doping, high electrical conductivity ease of preparation and low cost. Conducting polymer Composites are required in many engineering applications, especially electromagnetic compatibility. conducting polymer (PANI) and its composites are prepared by oxidation of aniline and the polyaniline composites were prepared by in situ polymerization method with dispersion of Lead oxide (PbO) and microwave properties such as the permittivity, return loss and electromagnetic interference shielding effectiveness (EMI-SE) of composites in the frequency range 8-12 GH_z is discussed in this paper and the maximum EMI-SE is observed in 10 wt% PbO in PANI,*

Key Words; *Polyaniline, Composites, Electromagnetic, microwave, shielding*

I. Introduction

The electromagnetic radiation interference is one of the unfortunate by-products of the rapid proliferation of electronic devices. These are undesired conducted or radiated electrical disturbance including transients which can interfere with the operation of electrical or electronic components. The polymer materials have attraction for microwave radiation absorbing and shielding materials in the GHz frequency range due to their unique chemical and physical properties. The shielding material is very important in microwave absorbing materials for lightweight and strong absorption properties [1]. The use of plastic materials to the housing of computer and electronic devices has been growing very rapidly due to their advantages over metals, like light weight, design flexibility, low cost and easy to mass production. As such plastic casing of electronic equipment do not provide protection from external field [2]. Composites such as metal particles, metal flakes, carbon particles, carbon fibers are extensively employed in electromagnetic interference (EMI) **s**hielding [3-5], we have synthesized conducting polymer composite with a PbO. The present investigation deals with the shielding effectiveness of the polyaniline composites, we have studied microwave absorption properties of these composites in X band microwave region.

II. Experimental

0.1 mol of aniline was dissolved in 1M HCl to form Polyaniline (PANI). Lead oxide (PbO) is added in the weight percent of 10, 30, and 50 to PANI solution with vigorous stirring in order to keep the Lead oxide (PbO) suspended in the solution. To this reaction mixture, 0.1 M 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 – 5 ^{0} C. The precipitated powder recover was vaccum filtered and washed with de ionized water. Finally the resultant precipitate was dried in an oven for 24 hours to achieve a constant weight. In this way 3 different polyaniline - PbO composites with different wt % of PbO (10, 30, and 50) in polyaniline have been synthesized.

All the composites so obtained above are crushed into fine powder in an agate mortar in the presence of acetone medium. .

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 significant variation in the whole frequency range used in the present work. However the ε' values increased with the increase of frequency in multi bands and ε' value increase with the decrease of PbO content in Polyaniline and this may be due to interfacial polarization. The ε'' spectra show the significant variation and decreases with the increase of frequency in multi bands. 30wt% of PbO in PANI shows maximum value, this may be due to the lag in polarization vis a vis the applied field.

Figure 2 shows the electromagnetic wave absorption (return loss) properties in X-band frequency (8 to 12 GHz). These composite shows increase in return loss value as frequency increases and also observed that the 10wt% of PbO in PANI shows maximum return loss this may be due to resonance, the return loss spectra also show multi band spectra this is due to the resonance between the material and the applied frequency.

Figure 3 shows the variation of EMI-SE at X-band frequency (8 to 12 GHz). The EMI-SE spectra of all the sample shows multiple bands except 10wt% of PbO in PANI with significant variation in the whole frequency range. However maximum EMI-SE values is observed for 10 wt% PbO in PANI and also observed that different compositions show different EMI-SE values (varies from 52 to 100). This may be due to the orientation of domains remained perpendicular to the direction of wave propagation.

IV. Conclusions

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

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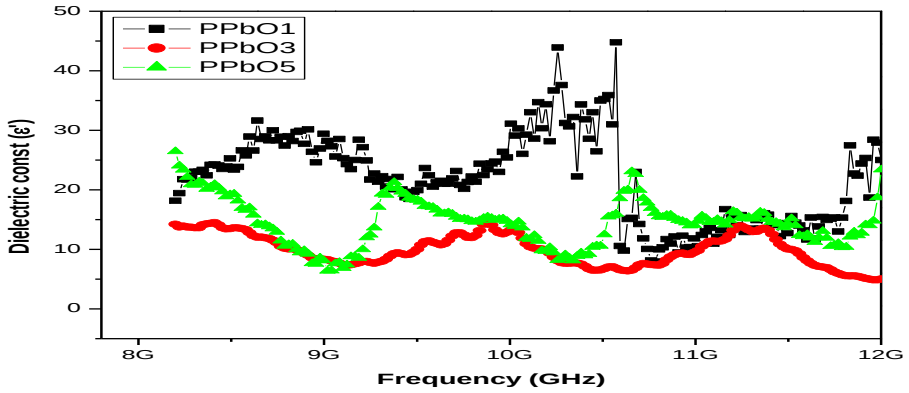

Figure 1 (a):Variation of Dielectric constant (ε') Vs Frequency (PANI / PbO)

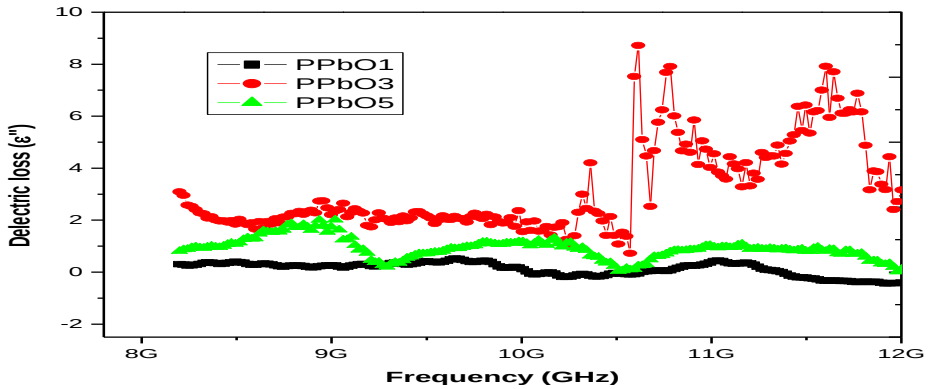

Figure 1 (b):Variation of Dielectric loss (ε'') Vs Frequency (PANI /PbO)

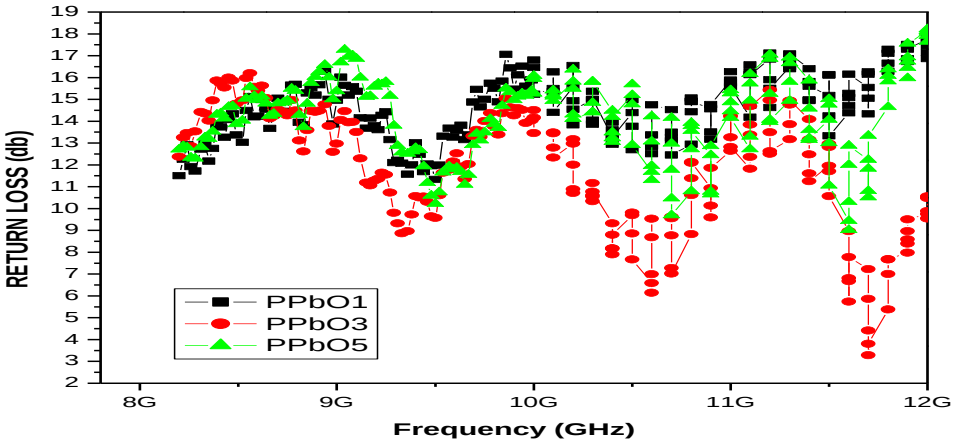

Figure 2:Variation of Return loss Vs Frequency (PANI / PbO)

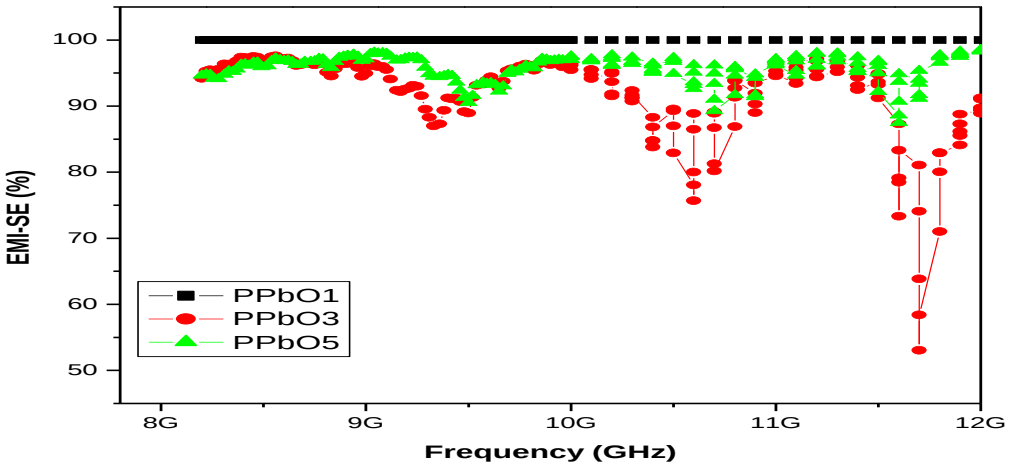

Figure 3:Variation of EMI-SE Vs frequencies (PANI / PbO)