Conclusions in Doctor Thesis: Some International Findings

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Title: Preparation and evaluation of particulate composites for microwaves absorbing applications.

Conducting microwave absorbing materials (MAMs) are generally used for anechoic chamber. The front surface has then been minimum surface area compare to rear surface area like; pyramids or the amount of lossy filler material was more in depth into the substrate. Magnetic absorbing materials have been based on magnetic metallic materials, carbonyl iron and hexaferrites are used in the application of GHz frequency ranges. Carbon black, fibrous carbon and reinforcement (E-glass/GFRP) have been incorporated into single layer absorbers. Radar/ Microwave absorbing materials (RAMs/ MAMs) have been synthesized by adopting different processes. Exfoliated graphite (EG) as conducting materials and U-type barium hexaferrite (BHF) as a magnetic materials ($Ba_4Me_2Fe_{36}O_{60}$; where Me is divalent transition materials) have been synthesized using a microwave assisted heat exfoliation and solid state reaction process respectively. Synthesized materials, EG was characterized by different techniques like; X-ray diffraction (XRD), Field emission scanning electron microscopy (FESEM), Energy dispersive X-ray analysis (EDAX) and RAMAN spectroscopy. while, U-type BHF was characterized with XRD, transmission electron microscopy (TEM), FESEM, EDAX and vibrating sample magnetometer(VSM) techniques. The particulate composites with epoxy resin system were prepared by thoroughly mixing the synthesized dispersive materials. Prepared composites have been made in toroidal shape by using a steel die mould of 3.0mm inner and 7.0mm outer diameter. The viscous mix of synthesized materials and epoxy was filled in the steel mould and was compressed in a hydraulic press with maintaining the temperature and pressure at 60°C and 10 mega Pascal (MPa) respectively, for a curing time of two hours. Further, 6 X 6 inches radar absorbing structures (RAS) composites have also been prepared by magnetic/ conducting filler loaded in E-glass/GFRP-epoxy. This semi-cured single layer composite system was subjected to compression molding in a hydraulic press at room temperature and a pressure of 100 MPa for a curing time of 24 hrs at room temperature curing. Further, it is post cured at elevated temperature

with constant pressure. Electromagnetic properties in terms of complex permittivity ($\varepsilon_r=\varepsilon'-j\varepsilon''$) and complex permeability ($\mu_r=\mu'-j\mu''$) of the prepared composites were analyzed from the measured scattering parameters (S11, S22, S21 and S12) by using an Agilent vector network analyzer (E8364B) and its software module (85071E). These EM properties were employed in the calculation of reflection/ return loss (RL) of prepared composites with varying thicknesses. Further tensile, flexural test of prepared RAS composites were performed as per ASTM standard. Based on the calculated and measured results, prepared composites have potential use as excellent microwave absorbers in 2-18 GHz frequency range.

Some findings as research papers published as proceeding and international SCI Journals:

[7] **Vivek Pratap**, A.K. Soni, Himangshu B. Baskey, S.M. Abbas, A.M. Siddiqui, N. Eswara Prasad, "Electromagnetic and radar absorbing properties of γ $Fe_2O_3/Ba_4Co_2Fe_{36}O_{60}$-epoxy polymeric composites for stealth applications" *Solid State Sciences*, 113 (2021) 106553 1-10.
DOI: 10.1016/j.solidstatesciences.2021.106553

[6] **Vivek Pratap**, A.K. Soni, S.M. Abbas, A.M. Siddiqui, N. Eswara Prasad, "Effect of Zinc Substitution on U-type Barium Hexaferrite-Epoxy Composites as Designed for Microwave Absorbing Applications" *Journal of Alloys and Compounds*, 865 (2021) 158280 1-11.
DOI: 10.1016/j.jallcom.2020.158280

[5] Bhoopendra Singh, **Vivek Pratap**, Mohit Katiyar, S.M. Abbas, Y.K. Sharma, A.M. Siddiqui, N. Eswara Prasad, "Engineering of dielectric composites on electromagnetic and microwave absorbing properties for operational in the X-band" *Journal of Advanced Dielectric*, 11 (2021) 2150001 1-5.
DOI: 10.1142/s2010135x21500016

[4] Rimpa Jaiswal, Kavita Agarwal, **Vivek Pratap**, Amit Soni, Subodh Kumar, Kingsuk Mukhopadhyay, N. Eswara Prasad, "Microwave-assisted preparation of magnetic ternary core-shell nanofiller (CoFe2O4/rGO/SiO2) and their epoxy nanocomposite for microwave absorption properties" *Materials Science & Engineering B*, 262 (2020) 114711 1-10.
DOI: 10.1016/j.mseb.2020.114711

[3] **Vivek Pratap**, A.K. Soni, A.M. Siddiqui, S.M. Abbas, R. Katiyar, N.E. Prasad, "Dielectric and radar absorbing properties of exfoliated graphite dispersed epoxy composites" *Journal of Electronics Materials*, 49 6 (2020) 3972-3981.

DOI: 10.1007/s11664-020-08118-6

[2] **Vivek Pratap**, B. Singh, S. Kumar, A.K. Soni, M. Katiyar, K. Agarawal, Y.K. Sharma, A.M. Siddiqui, S.M. Abbas, N.E. Prasad, "Electromagnetic and microwave absorbing properties of U-type barium hexaferrite / polyaniline-epoxy composites" American Institute of Physics Conf. Proc. 2220 (2020) 080003 1-5.

DOI: 10.1063/5.0001890

[1] **Vivek Pratap**, A.K. Soni, S. Dayal, S.M. Abbas, A.M. Siddiqui, N.E. Prasad, "Electromagnetic and absorption properties of U-type barium hexaferrite epoxy composites" *Journal of Magnetism and Magnetic Materials*, 465 (2018) 540–545.

DOI: 10.1016/j.jmmm.2018.06.027

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