Notice for the PhD Viva Voce Examination

Ms Muthamma M V (Reg. No. 1445204), PhD scholar at CHRIST (Deemed to be University), will defend her PhD thesis at the public viva voce examination on Thursday, 29 April, 2021 at 11.00 am. The defense will be conducted online on the Webex Meeting platform.

Title of the Thesis	:	**Polyvinyl Alcohol and Epoxy based Composites for Radiation Shielding Applications**
Discipline	:	**Physics**
External Examiner (Outside Karnataka)	:	**Dr Ramasubramanian V** Professor Department of Physics VIT University Vellore – 632014 Tamil Nadu
External Examiner (Within Karnataka)	:	**Dr R F Bhajantri** Professor Department of Studies in Physics Karnatak University Dharwad- 580003 Karnataka
Supervisor	:	**Dr Bubbly S G** Professor Department of Physics and Electronics School of Sciences CHRIST (Deemed to be University) Bengaluru – 560029 Karnataka

The faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva.

Registrar

Place: Bengaluru
Date: 23 April 2021

ABSTRACT

The present study has been focused towards designing efficient, non-toxic and cost-effective shielding materials with good mechanical strength for protection against radiations encountered in various environments like aerospace, hospitals, research and nuclear reactor establishments. From this perspective, to impart desired shielding properties, high Z filler dispersed polymer matrices such as Bi/WO_3-polyvinyl alcohol (PVA), Ta_2O_5-epoxy, Ta_2O_5-Bi_2O_3-epoxy, micro Bi_2O_3-epoxy and nano Bi_2O_3-epoxy with varying filler contents have been synthesized. Structural characterizations were carried out using X-ray diffraction (XRD) and Fourier transform infrared (FT-IR) spectroscopy to reveal the interactions between filler and polymer matrix. The morphological analyses were performed using scanning electron microscopy (SEM) images. The AC conductivity measurements and optical studies revealed low conductivity property of the composites. The thermo gravimetric analysis (TGA) and mechanical studies were conducted to ascertain thermal stability and mechanical properties of the composites. With increase in filler concentration mechanical properties of Bi/WO_3-PVA composites were found to be weakening. The TGA studies of Bi/WO_3-PVA composites showed decrease in peak degradation temperature with increase in filler content. This prompted us to further design epoxy composites as epoxy matrix has good thermal stability and mechanical strength. Compared to neat epoxy, dispersion of varying wt% of Ta_2O_5 and Bi_2O_3 into epoxy matrix led to significant improvement in stiffness, storage modulus, glass transition temperature and thermal stability of the composites. Epoxy composites with 5 wt% of Ta_2O_5 and 30 wt% of Bi_2O_3 revealed better thermal and tensile properties when compared to same wt% Bi_2O_3 filled epoxy composites. The synergistic influence of micro and nano Bi_2O_3 filler on epoxy matrix composites showed similar thermal behaviour. Significant enhancement in mechanical property was observed at lower filler loadings of nano Bi_2O_3 comparable with higher wt% micro Bi_2O_3-epoxy composites. X-ray and γ-ray attenuation behaviour of Bi/WO_3-PVA, Ta_2O_5-epoxy, Ta_2O_5-Bi_2O_3-epoxy micro/nano Bi_2O_3-epoxy composites were studied using CdTe and NaI(Tl) detector spectrometers, respectively at various energies. Mass attenuation coefficients (μ/ρ) of the composites at various energies of X-rays and γ-rays from ^{55}Fe (5.895 keV and 6.490 keV), ^{241}Am (59.54 keV), ^{22}Na (0.511 and 1.28 MeV), ^{137}Cs-137 (0.662 MeV), ^{133}Ba (0.356 MeV) and ^{60}Co (1.173 and 1.332 MeV) point sources were determined. Experimental μ/ρ values for all the composites were compared with theoretical values computed using WinXCom and were found to be in good agreement.

The investigation on superiority of Ta_2O_5 and Bi_2O_3 filled epoxy composites and nano Bi_2O_3 filled composites, relative to other composites was manifested on the dependence of intrinsic property of the filler and the photon energy. However, all the studied composites also demonstrated good radiation shielding. Bi-PVA composites showed higher μ/ρ values compared to WO_3-PVA composites for X-ray and γ-ray photon energies. Novel epoxy composites having both Bi_2O_3 and Ta_2O_5 fillers showed similar μ/ρ values when compared with epoxy composites having only Ta_2O_5 fillers. Effective atomic number (Z_{eff}), electron density (N_{eff}) and other radiation attenuation parameters such as half-value layer (HVL), tenth-value layer (TVL) and relaxation length (λ) were calculated from the experimental μ/ρ values. These investigations assess the experimental evidences of possibility and perspectives of using Ta_2O_5-Bi_2O_3-epoxy composites and nano Bi_2O_3-epoxy composites as optimal radiation shields when exposed to low and high energy X-rays and γ-rays.

Keywords: Bi-PVA and WO_3-PVA composites, micro/nano Bi_2O_3-epoxy composites, AC conductivity, optical properties, mechanical properties, thermal properties, mass attenuation coefficients, Z_{eff} and N_{eff}.