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Free volume characteristics and thermal properties of thin layers of poly vinyl acetate (PVAc) adsorbed on fumed Silica

S. K. Sharma[1], K. Sudarshan[1], M.Sahu[2] and P. K. Pujari[1]

[1]Radiochemistry Division, [2]Radioanalytical Chemistry Division, Bhabha Atomic Research Centre, Trombay, Mumbai – 400085, India

email: pujari@barc.gov.in

Bulk physical properties like thermal, mechanical and electrical of polymer nanocomposites are shown to be improved as compared to pure polymers [1]. The enhancement in the properties is attributed to the formation of an interfacial layer having distinct molecular packing around the nano-fillers due to interfacial interactions [2]. Characterization of molecular packing of thin polymer layer around nanofillers (interfacial layer) and its role in bulk physical properties of the polymer nanocomposites is an active area of research. In the recent years, it has been shown that positron annihilation lifetime spectroscopy (PALS) can be used to investigate the free volume structure of polymer nanocomposite films. However, it is difficult to obtain the exclusive information about the free volume structure of interfacial layer in the presence of significant amount of bulk like polymer layer [3-6]. In order to investigate the free volume structure of interfacial layer, equivalent thin layers of variable thickness of Poly vinyl acetate (PVAc) have been adsorbed on fumed silica particles from a dilute PVAc solution. A large fraction of positrons implanted in the silica particles diffuse out to their surface where they annihilate within the adsorbed polymer layers. PALS measurements of the PVAc coated fumed silica samples have shown significant changes in the free volume characteristics of the adsorbed layer depending on the amount or thickness of PVAc. Differential scanning calorimetry (DSC) measurements showed the changes in the glass transition process such as shifting in glass transition temperature (T_g) as well as occurrence of two T_g. Thermal gravimetric analysis (TGA) of the coated samples has shown an enhancement in the decomposition temperature of the adsorbed PVAc layers. The observed changes in the thermal properties will be discussed vis- a- vis free volume characteristics of the thin layers.

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