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# Immiscible Polymer Blends with Controlled Nanoparticle Location for Excellent Microwave Absorption: A Compartmentalized Approach

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**Abstract :** In order to obtain better materials, control in the precise location of nanoparticles is indispensable. It was shown here that ordered arrangement of nanoparticles, possessing different characteristics (electrical/magnetic dipoles), in the blend structure can result in excellent microwave absorption. This is manifested from a high reflection loss of ca. -67 dB for the best blend structure designed here. To attenuate electromagnetic radiations, the key parameters i.e. high electrical conductivity and large dielectric/magnetic loss are targeted here using a conducting inclusion [multiwall carbon nanotubes, MWNTs]; ferroelectric nanostructured material with associated relaxations in the GHz frequency [barium titanate, BT]; and a loss ferromagnetic nanoparticles [nickel ferrite, NF]. In this study, bi-continuous structures were designed using 50/50 (by wt) blends of polycarbonate (PC) and polyvinylidene fluoride (PVDF). The MWNTs was modified using an electron acceptor molecule; a derivative of perylenediimide, which facilitates π-π stacking with the nanotubes and stimulates efficient charge transport in the blends. The nanoscopic materials have specific affinity towards the PVDF phase. Hence, by introducing surface-active groups, ordered arrangement can be tailored. To accomplish this, both BT and NF was first hydroxylated followed by introducing amine-terminal groups on the surface. The latter facilitated in nucleophilic substitution reaction with PC and resulted in their precise location. In this study, we have shown for the first time that by compartmentalized approach, superior EM attenuation can be achieved. For instance, when the nanoparticles were localized exclusively in the PVDF phase or in both the phases, the minimum reflection loss was ca. -18 dB (for MWNT/BT mixture) and -29 dB (for MWNT/NF mixture), and the shielding was primarily through reflection. Interestingly, by adopting the compartmentalized approach where in, the lossy materials were in the PC phase and the conducting inclusion (MWNT) in PVDF, an outstanding reflection loss of ca. -57 dB (for BT and MWNT combination) and -67 dB (for NF and MWNT combination) was noted and the shielding was primarily through absorption. Thus, the approach demonstrates that nanoscopic structuring in the blends can be achieved under macroscopic processing conditions and this strategy can further be explored to design microwave absorbers.

**Keywords :** barium titanate, EMI shielding, MWNTs, nickel ferrite
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