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Electrical and electromagnetic shielding effectiveness behavior of different epoxy/Graphene Related Materials nanocomposites

Dos Anjos, E.G.R.(1); Brazil, T.R.(2); Pessan, L.A.(3); Passador, F.R.(2); Rezende, M.C.(2); Baldan, M.R.(4); Morgado, G.F.M.(2); Antonelli, E.(2);
(1) UFSCAR; (2) UNIFESP; (3) UFSCar; (4) INPE;

Graphene is a 2D nanomaterial that presents exceptional electrical and mechanical and consists of a single layer of sp^2 hybridized carbon atoms in a hexagonal pattern. However, the application of graphene as its ideal form has been an engineering and industrial challenge, which has led to a range of materials called Graphene Related Materials (GRM). Graphene Nanoplates (GNP) are highlighted among the GRM to improve the properties of polymers in nanocomposites, preserving the easy processability of polymers with the excellent electrical and thermal conductivities related to the graphene layers structure. These nanofillers have been highlighted to improve the electromagnetic shielding effectiveness (EMI SE) and electrical properties of polymer nanocomposites due to their low density and high chemical resistance compared to the metals commonly applied for EMI SE applications. This study evaluated different GRM in epoxy nanocomposites' electrical and EMI SE behavior. An epoxy (ValGlass® -GY 297 BR) resin with fast-curing systems and four different GRM were selected to evaluate the effect of the lateral size, obtaining process, and thickness. The GRM contents evaluated for each GRM were 5, 10, and 15%, and the preparation of the nanocomposites was proceeded by the following steps: first, the mechanical mixing of the components, adding the GRM into the epoxy precursors; Second, the composition was converted into a silicon mold; and then the mold was placed into an oven at 70°C for 2 hours. After preparation, the samples were characterized by X-Ray diffraction (XRD), Scanning Electronic microscopy (SEM), impedance (or dielectric) spectroscopy, and EMI SE. According to the XDR results, each GRM was in a different average thickness dispersion, and most of the nanocomposites presented agglomerates of the GRM. The impedance results have shown a proportional increase in the total electrical conductivity of the nanocomposites with the GRM content added, which was not strictly related to the thickness and lateral size of the filler. Finally, from the EMI SE results, the lower thickness of G2 resulted in higher total shielding efficiency (SET ~7dB), and the G3 processes of production by chemical exfoliation resulted in higher shielding efficiency by absorption component (SEA ~ 2dB). In a significant conclusion, the content of each GRM had shown to be the most critical parameter for the electric and EMI SE behavior of the nanocomposites, and the GNP with the lower thickness (G2) presented a higher attenuation component. The authors would like to thank FAPESP for financial support (Process 2021/10136-3).