Development, Characterization, and Energy Storage of Polar Oxides/Polymer Matrix Nanodielectrics

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Polymer matrix composites incorporating ceramic nanoinclusions receive enhanced scientific and technological interest, because of their advanced performance, which includes high dielectric permittivity, and dielectric strength, in tandem with light weight, flexibility, corrosive resistant, good mechanical behaviour and ease processing [1-3]. This type of materials, which is also referred as nanodielectrics, appears to be able to replace conventional insulating materials in numerous applications. Furthermore, current emerging technologies such as stationary power systems, cellular phones, wireless personal digital assistants and hybrid electric vehicles require materials' systems where energy could be stored and harvested.
Nanodielectrics consisted of a polymer matrix and polar oxides nanoparticles exhibit tunable polarization. The latter is related to the piezoelectric and/or ferroelectric behaviour of the employed ceramic particles [3-5]. In this study various ceramic polar oxides are as used reinforcing phase in a commercially available epoxy resin. The employed fillers are $BaTiO_3$, $ZnTiO_3$, ZnO, TiO_2 nanoparticles. For each type of nanofiller a series of nanocomposites is prepared varying the ceramic content. Morphology, thermal properties, and dielectric response are investigated by means of scanning electron microscopy, differential scanning calorimetry, and broadband dielectric spectroscopy, respectively. Data analysis is focused in realizing the optimum type and amount of reinforcing phase with respect to dielectric behaviour, functionality and energy storage efficiency.

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