Barium Titanate or Carbon/Polydimethylsiloxane Nano/Micro-composites: Dielectric Response, Functional behavior and Energy Storage

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Introduction

The scientific and technological impact of nanostructured materials is well established and appreciated nowadays, because of the improvement in electrical, thermomechanical properties etc. and the resulting potential for numerous applications. One group of smart materials is nanodielectrics, which includes polycrystalline semiconducting or insulating materials, with grain diameter at the nanoscale level and polymer composites incorporating nanoinclusions. The dielectric behaviour of elastomer nanocomposites can be tailored by simply controlling the type, size and amount of the nanofiller. In this work polydimethylsiloxane composites reinforced with (1) microsize barium titanate ($BaTiO_3$), (2) nanosize barium titanate ($BaTiO_3$), (3) graphite nanoplatelets (GNP), (4) carbon black, (5) multiwalled carbon nanotubes (MWCNTs) were fabricated and studied, in terms of the type, size and amount of the filler content.

Methods

Dielectric measurements were performed via Broadband Dielectric Spectroscopy (BDS) in the frequency range from 10^{-1} Hz to 10^6 Hz. Temperature was varied between 30^{o}C and 200^{o}C at steps of 5^{o}C.

Results

Both the real part of dielectric permittivity and energy storage increase with filler content and temperature and diminishing with frequency.

Conclusions

Dielectric spectra reveal the presence of two relaxation processes arising from the re-orientation of polar side groups of the polymer chains (β-mode) and the interfacial polarization, due to the accumulation of charges at the interfaces between crystalline, amorphous regions and filler.

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