BARIUM STRONTIUM TITANATE/EPOXY RESIN NANOCOMPOSITES AS COMPACT ENERGY STORAGE & HARVESTING DEVICES - CONDUCTIVITY ANALYSIS

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ABSTRACT

In this work, nanocomposite systems consisted of epoxy resin and Barium Strontium Titanate nanoparticles (BST) have been prepared and studied varying the filler content. The main scope was the examination of the ability of the nanodielectric system to store and harvest energy under DC conditions. The improvement of energy efficiency of such material device constitutes an important task to be investigated and its applicability is very crucial in the field of electronics [1]. The presence of the nanofiller enhances the energy efficiency of the system. For the evaluation of the system's performance the coefficient of energy efficiency (n_{eff}) has been introduced, being the ratio of the energy discharged upon the energy charged. The highest value of n_{eff} was achieved for the 1phr BST nanocomposite (n_{eff}=65.92%) at 50V applied voltage. Furthermore, the increase of temperature diminishes the n_{eff} values rapidly in all studied voltage levels. The n_{eff} reduction is attributed to the leakage currents increment and the affection of the glass to rubber transition of the polymer matrix. Power study was also performed, and it was found that the power density of BST nanocomposite systems increases upon temperature [2].

In addition, extensive conductivity analysis was performed in both AC and DC conditions as a function of temperature in all studied BST nanodielectrics. The temperature dependence of conductivity in both cases follows an Arrhenius form. The demanded activation energy (E_A) of the charges in order to overcome the potential barrier has been calculated in all cases. Values of E_A reflect the dominating, each time, interactions within the nanodielectrics and E_A in DC conditions acquire higher values than in AC ones. Finally, hopping conduction was found to be the predominant conduction mechanism, in all studied cases, since Variable Range Hopping (VRH) model is in good agreement with conductivity experimental data [3,4].

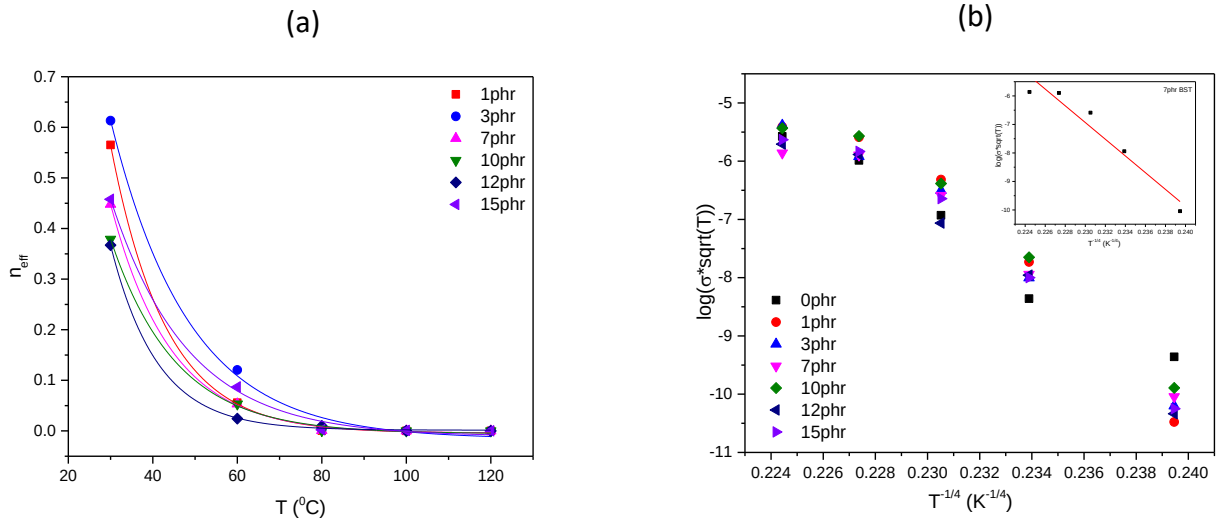

Figure 1. (a) Coefficient of energy efficiency (n_{eff}) at 100V for the time instant t=10s as a function of temperature for all BST nanocomposites and (b) conductivity data as described by VRH model at 50V for all BST specimens.

REFERENCES

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