Integrating Multi-Functionality in $Fe_3O_4/BaTiO_3$/Epoxy Resin Hybrid Nanocomposites

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Modern global society exhibits a continuously increasing demand for new high-tech products, equipment and services, the performance of which requires the development of novel and advanced engineering materials. Materials play a key-role in the whole range of technological applications, related to transportation, energy, electrical and electronic applications, mechanical engineering, structural performance, biomedical applications, sports industry, and others.

Multifunctionality is the combination of various desirable properties in a material or materials' system, aiming to develop a single material/system exhibiting all necessary responses under various loading conditions at service. Mechanical sustainability, suitable thermal response, tunable electric conductivity, variable electric polarization and dielectric permittivity, magnetic properties, thermally induced phase changes could be parts of the overall multifunctional behaviour, Figure 1.

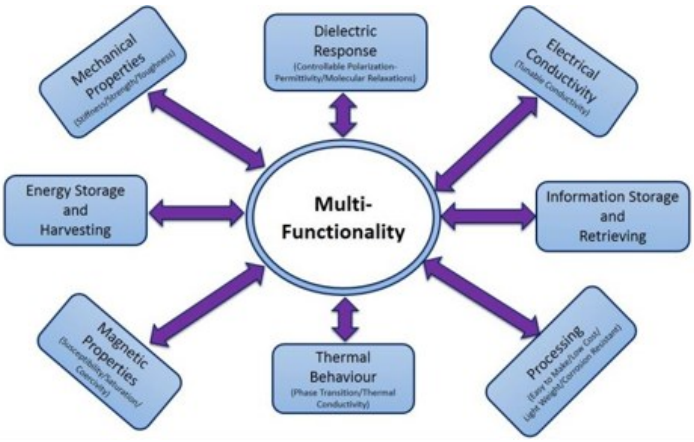

Figure 1: Schematic representation of materials' multifunctionality.

The challenge of the study is the development of a material/device being able to execute several functions (such as variable polarization, tunable dielectric response, adjustable conductivity, varying magnetic performance, energy storage and others), while being easy to make, light weight, cost effective exhibiting at the same time possessing structural integrity and suitable thermal response.

The under study nanodielectric materials are polymer matrix nanocomposites, reinforced with: (i) ferroelectric/polar oxides ($BaTiO_3$), and (ii) ferromagnetic (Fe_3O_4) nanoparticles.

Acknowledgements

The research work was supported by the Hellenic Foundation for Research and Innovation (H.F.R.I.) under the "First Call for H.F.R.I. Research Projects to support Faculty members and Researchers and the procurement of high-cost research equipment grant" (Project Number:2850).