

Editorial corner – a personal view

Nanodielectrics: an emerging sector of polymer nanocomposites

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In our days the scientific and technological importance of nanostructured materials is worldwide understood and recognized, giving rise to expectations for materials with superior or unique performance and properties. The term nanodielectrics is rather new and refers to dielectric materials, which comprise entities with dimensions (at least one) at the nanometric scale. Two are the basic categories of nanodielectrics: (a) polycrystalline semiconducting or insulating materials, with grain diameter at the nanoscale level and (b) polymer composites incorporating nanoinclusions. The second category displays a number of advantages, e.g. easy processing and thermo-mechanical stability. Moreover the dielectric behaviour can be tailored by simply controlling the type and the amount of the nanofiller. Under this point of view, polymer matrix nanocomposites are expected to replace conventional insulating materials in a variety of applications.

Capacitance the fundamental quantity in dielectrics, in contrary with other physical quantities, is increasing as the dimension of width in nanoinclusions is decreasing. This fact gives the possibility to exploit nanoinclusions as an inherent system of nanocapacitors. The charging and discharging of nanocapacitors defines an energy storing process, at the nanoscale level, introducing a new type of nanodevices. Nanofillers are frequently used as structural elements in nanocomposite systems. In some cases, the same elements could be able to act as nanocapacitors or 'structural batteries'. Furthermore, the presence of 'active dielectrics' (i.e. piezo/ferroelectric or polar

oxides nanoparticles) within the polymer matrix could provide functionality to the nanocomposite, through the conditionally variable electrical polarization. Combining mechanical and electrical reinforcement with energy storing procedure and functionality leads to a significant approach to the concept of 'smart materials', where structural elements should also play the roles of sensing, actuating and energy storing sub-systems.

Finally, the importance of studying conduction mechanisms in polymer matrix – conductive nanoinclusions composites should be noted. The insulator to conductor transition is expected to occur at a low content of the conductive phase, while the temperature and field dependence of conductivity can be exploited for the development of self-current regulators, self-heating systems, memory switches and other applications.

Definitely a lot should be expected from this field in the near future.



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