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Surface modified barium titanate for optimal dielectric properties in polymer-ceramic nanocomposite films

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High permittivity polymer-ceramic nano composite dielectric films leverage the ease of flexibility and processing of polymers and functional properties of ceramic fillers. Physical characteristics of these materials can be tuned for application to a variety of applications such as, advanced embedded energy storage devices for printed wired electrical boards and battery seperators. In some cases, the incompatibility of the two constituent materials; hydrophilic ceramic filler and hydrophobic epoxy can limit the filler concentration and therefore, dielectric properties of these materials. Use of surfactants and core-shell processing of composite fillers is traditionally used to achieve electrostatic and steric stabilization for adequate ceramic particle distribution. This work aims to understand the role of surfactant concentration in establishing meaningful interfacial layers between the epoxy and ceramic filler particles by observing particle surface morphology, dielectric permittivity and device dissipation factors. A comprehensive study of nanocomposites that were comprised of non-treated and surface treated barium titanate (BT) embedded within an epoxy matrix was performed. The surface treatments were performed with ethanol and 3-glycidyloxypropyltrimethoxysilan, where the best distribution, highest value of permittivity (~ 48.03) and the lowest value of loss (~0.136) were observed for the samples that were fabricated using 0.5 volume fraction of $BaTiO_3$ and 0.02 volume fraction of silane coupling agent

Biography

Kimberly Cook-Chennault is an Associate Professor in the Mechanical and Aerospace Engineering Department at Rutgers University. She holds BS and MS degrees in Mechanical Engineering from the University of Michigan and Stanford University respectively; and a PhD from the University of Michigan, Ann Arbor. Her research interests include design of integrated hybrid energy systems and investigation of the structure-property relationships in dielectric and piezoelectric films and bulk composites for sensing/actuation and energy storage/harvesting. Cook-Chennault's research group, the Hybrid Energy Systems and Materials Laboratory, conducts work to understand the mechanisms and processing parameters that enable control of physical material characteristics.

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