J Ind Electron Appl 2021, S10

Journal of electrical engineering and electronics technology

Short Communication

A SCITECHNOL JOURNAL

Nanostructure Controlled Polymer-Ceramic Composites with Improved Interface

Douglas B. Chrisey1

Tulane University, USA

Abstract:

Polymer ceramic nanocomposites with carefully designed interface structure can provide high energy density (~as high as 22 J/cm3) needed for the next generation of dielectric capacitors for large scale energy storage. We have prepared thiol-ene polymer matrix from a mixture of thiol and alkene monomers using large-scale method of photonic curing. Monomers of Pentaerythritoltetrakis (3-mercaptopropionate), 2,4,6 Triallyloxy-1,3,5- triazine and 1,3- Diisopropenylbenzene undergo click reactions and polymerize using a radical mediated process. When surface engineered barium titanate nanoparticles (~100 nm) are incorporated in the monomer mixture, these particles also click with the monomers to form a nanocomposite material.

Barium titanate nanoparticles are surface engineered by using a three-step process: hydroxylation, silanization and monomer grafting. An alkene-ended silane (3-Acryloxypropyltrimethoxysilane) is used for silanization and thiol monomers are grafted from the alkene ends. The radicals during the preparation of nanocomposites are formed by activation of thiol monomers by intense pulses of light from a xenon flash lamp removing the requirement of photoinitiator in the final step. Also, the composition of materials in this work is designed to match the stoichiometric ratio of thiol and alkene functional ends. Covalent bond formed at the interface and improved dispersion resulting from the combined effect of silane and the grafted monomer results in nanocomposites with improved properties. The resulting nanocomposites show energy density as high as 22 J/cm3 even at a low nanoparticle loading while the dielectric loss is maintained below 0.2. Tailoring the interface structure at the nanometric level to obtain desired properties is a difficult task. It can be even more challenging when tailoring should be done in parallel while preparing nanocomposites in large scale using a cost effective method. The photonic curing process utilized in this work is a rapid, high-throughput and roll-to-roll amenable method. This study provides an easy route to an industrial scale method for the production of high energy density nanocomposites.

Biography

He is a professor in Tulane University, USA.

Publication of speakers

1. Effect of Crystallizable Glass Addition on Sintering and Dielectric Behavior of Barium Titanate Ceramics.
2. EVALUATION OF ELECTRIC CELL-SUBSTRATE IMPEDANCE SENSING FOR THE DETECTION OF NANOMATERIAL TOXICITY

Citation: Chrisey.D, Nanostructure Controlled Polymer-Ceramic Composites with Improved Interface, May 20-21, 2021, Osaka, Japan