Characterization of Micron-scale Nanotubular Super Dielectric Materials

ABSTRACT

This research is part of an ongoing program of study focused on dielectric materials based on a novel hypothesis: that porous electrically insulating solids in which the pores are filled with liquids containing an ionic species (such as water with dissolved salt) will have very high dielectric values by virtue of the separation of ions in the liquid phase and concurrent formation of large dipoles. Earlier work focused on the creation of super dielectric materials by saturating porous electrically insulating powders, such as alumina, with salt solutions. The focus of the present work is the characterization and evaluation of capacitors based on a novel dielectric: titanium dioxide nanotube arrays created by anodization and filled with a concentrated aqueous salt solution. Capacitors made up of this so-called nanotubular super dielectric material were found to have extreme dielectric constants, greater than one billion. The same capacitors also registered unprecedented energy densities, consistently greater than 400 joules per cubic centimeter, which is more than ten times the best commercial supercapacitors. Sufficient data was collected to propose a correlation relating dielectric thickness, salt concentration, and electrode surface area to overall energy density.

INFORMATION

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