Chimica Verde | Energie Rinnovabili | Salute | Materiali | Modelling | Beni Culturali

Conferenza di Dipartimento 2018

DSCTM

Department of Chemical Sciences and Materials Technology

24-25-26 SETTEMBRE
ASSISI
GRAND HOTEL ASSISI

Organizzazione Giornate di Dipartimento 2018
24-25-26 Settembre, Assisi

Comitato Organizzatore (Roma)

Caterina Adinolfi
Floriana Bernabucci
Federica Criscuoli
Giuliana Quaglia
Mario Figuretti
Cinzia Fraschetti
Francesco Verginelli

Comitato Organizzatore (Perugia)

Olivia Bizzarri
Lucia Allegretti
Beatrice Bizzarri
Filippo De Angelis
Costanza Miliani
Edoardo Mosconi
Simona Fantacci
Leonardo Belpassi
Laura Cartechini
Francesca Rosi

Comitato Scientifico - Premio YIA2018

Doriano Lamba (Coordinatore)
Lucia Curri
Filippo De Angelis
Alessandro Lavacchi
Mauro Marchetti
Costanza Miliani
Alessandro Mordini
Giuseppe Palmieri
Maurizio Peruzzini
Maria Luisa Pompili
Paola Rizzarelli
Alessandra Sanson

Engineered Ferroelectric PVDF Composites Containing BaTiO3-based Core-shell Inclusions: Dielectric Properties and 3D FEM Modelling of Field Distribution

E. Brunengo,[a] G. Canu,[b] M. T. Buscaglia,[b] L. Conzatti,[a] C. Costa,[b] L. Curecheriu,[c] L. Mitoseriu,[c] L. Padurariu,[c] I. Schizzi,[a] V. Buscaglia,[b] and P. Stagnaro[c]

e-mail: vincenzo.buscaglia@ge.icmate.cnr.it

[a]Institute for Macromolecular Studies, National Research Council, Via De Marini 6, 16149 Genoa, Italy
[b]Institute of Condensed Matter Chemistry and Technologies for Energy, National Research Council, via De Marini 6, 16149 Genoa, Italy
[c]Department of Physics, Alexandru Ioan Cuza University, Iasi, Romania

The demand for high dielectric constant materials and high energy density capacitors has rapidly increased in recent years due to the continuous and rapid development of the electronic industry and the need to store electrostatic energy more efficiently. The high breakdown field typical of polymers can be preserved while increasing the effective permittivity, if ferroelectric inclusions are embedded in the polymer matrix by forming a composite, thus improving the stored energy density. The dielectric properties of the composite can be tailored by varying size, shape and volume fraction of the inclusions as well as the dielectric constant of the polymeric matrix, thus altering the electric field distribution inside the material. Moreover, the distribution of the electric field can be modified by coating the particles used as inclusions with an oxide layer with a different dielectric constant.

In this work we have fabricated polyvinyldene fluoride (PVDF) composites containing 30 vol.% $BaTiO_3$@ AO_2 (A = Si, Ti) particles and measured their dielectric properties. Barium titanate particles with a diameter of ≈100 nm were synthesized using a hydrothermal-like method and coated with a thin shell (≈10 nm) of SiO_2 or TiO_2 by means of colloidal chemistry methods. The composites were prepared by solution casting followed by compression moulding.

The dielectric properties of the composites (permittivity and loss tangent) were measured at different frequencies and several temperatures. The coating results in a significant modification on the effective permittivity, which is mainly determined by the value of its dielectric constant. To gain insight into the role of the coating layer, the electric field distribution and the effective dielectric constant were calculated for the different composites using a 3D finite element modelling and compared to experimental results.

Keywords: Dielectrics, composites, dielectric constant

Acknowledgement:
Work carried out in the framework of project Polycom funded by Fondazione Bancaria Compagnia di San Paolo.