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# CONFERENZA DI DIPARTIMENTO 2018

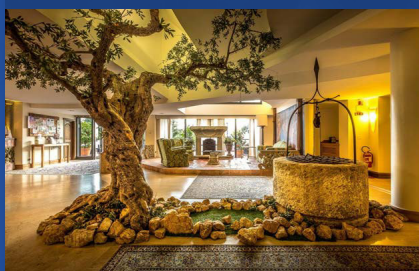
# DS@TM

Department of Chemical Sciences and Materials Technology

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## Engineered Ferroelectric PVDF Composites Containing BaTiO<sub>3</sub>-based Core-shell Inclusions: Dielectric Properties and 3D FEM Modelling of Field Distribution

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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 polyvinylidene fluoride (PVDF) composites containing 30 vol.% BaTiO<sub>3</sub>@AO<sub>2</sub> (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<sub>2</sub> or TiO<sub>2</sub> 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

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