

## PIEZOELECTRIC MATERIALS

Group leader CARMEN GALASSI

The Research activity covers the whole fabrication process of materials and prototypes, including powders synthesis, ceramic processing, densification, poling and functional characterization of piezoelectric materials in the system **PZT**, [Pb(Zr,Ti)O<sub>3</sub>], electrostrictive materials in the system **PMN**, [Pb(MgNb)O<sub>3</sub>] and lead free materials of type **BNT**, [(BiNa)TiO<sub>3</sub>].

Lead based piezoelectric materials (PZT) either of type "soft" or "hard" (mainly PZT doped with niobium, lanthanum, magnesium, manganese etc.) and components were fabricated for specific applications such as piezoelectric bulk actuators, multilayer actuators, transformer. The powders are synthesized either with the classic method of the **solid state reaction** or by **chemical methods** like the atomization of the solution of the precursors (spray drying), or sol-gel, including gel combustion. The production and characterization of piezoelectric materials with controlled porosity has given meaningful results for the applications of these materials with low acoustic impedance to devices operating in water (hydrophones). Moreover materials of the system lead magnesium niobate (PMN and PMN-PT) synthesized either with the columbite method or by "spray drying" of the solution of the precursors have been optimized. Recently the **gel combustion** technique was applied to the synthesis of PLZT nanosized powders. Within the lead-free systems the development of compositions of the type BNBT ((BiNa)TiO<sub>3</sub>-BaTiO<sub>3</sub>) is in progress.

The materials are currently shaped by die or isostatic pressing, **colloidal processing** of the suspensions of the powders, **tape casting** or starch consolidation and extrusion. The research unit holds a background general experience in the treatment of ceramic powders with particular reference to the characterization and optimization of suspensions to control the morphology of cold consolidated bodies and the microstructure of sintered materials. **Porous materials** with porosity volume ranging from few percent to 40 % are prepared with the addition of pore forming agents in the dry or wet state and functionally graded porosity materials were recently developed.

The activity is carried out in collaboration with National or International Institutions or funded Programmes and is spread through initiatives at national and International level .

As a fall out of the tutoring of students and young researchers a **spin-off** action was carried on and a new Company, **IPECC** (<http://www.ipecc.it>) was generated on 2005 that develops the complementary activity to support the companies to apply the piezoelectric technology to their processes.

## Papers related to Piezoelectric materials

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