Elaboration of $BaTiO_3$ lead-free piezoelectric thick films on thin metallic substrates by Aerosol Deposition method (AD)

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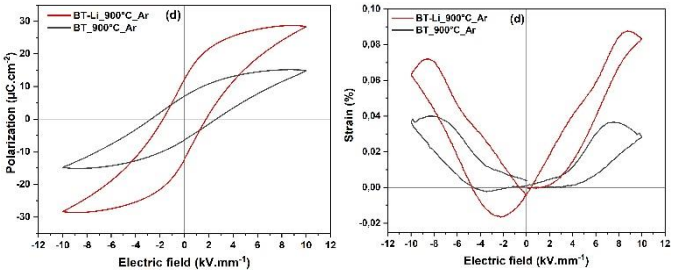
Abstract

Some piezoelectric devices (sensors, MEMS, energy-harvesting…) require thick films shaping on suitable flexible substrate. Currently, the available methods (screen printing, pad printing or tape casting) need thermal sintering of the active material after shaping. The Aerosol Deposition method (AD), introduced in Japan at the end of the 1990s, is a room temperature innovative method for the elaboration of thick ceramic films currently developed by IRCER and CTTC. In AD, a dry gaseous aerosol of ceramic powder particles is generated, transferred to the deposition chamber using a carrier gas and sprayed onto a substrate at supersonic speed. The high kinetic energy of particles allows obtaining directly dense thick ceramic coatings, by Room Temperature Impact Consolidation (RTIC). Although RITC is not yet fully understood, AD allows obtaining thick ceramic coatings without post-coating sintering.

By using AD, we successfully obtained dense NBT-6BT and $BaTiO_3$ thick film with high electrical resistivity and high dielectric strength. Due to RTIC, the as-deposited films present high stress level and nano-sized grains (5-25 nm), thus without macroscopic ferroelectric – piezoelectric properties because of grain size effect. Using suitable post deposition annealing parameters and Li additive, we successfully obtained for the first time on thin metallic substrates a ferroelectric / piezoelectric behaviour for $BaTiO_3$ and NBT-6BT films. A unimorph cantilever prototype device was elaborated, demonstrating the possibility of energy harvesting.



Recent Publications

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2. A. Chrir, O. Rojas, L. Boyer, O. Durand-Panteix, P. Marchet, Effect of post-annealing on microstructure and electrical properties of $BaTiO_3$ thick films grown by aerosol deposition (AD), *J. Eur. Ceram. Soc.* 44 (2024) 3965–3984
3. A. Chrir, O. Rojas, M. Colas, L. Boyer, O. Durand, P. Marchet, Towards lower annealing temperatures and enhanced functional properties in aerosol-deposited piezoelectric thick films: A study of the effect of Li additive on $BaTiO_3$ films, *J. Eur. Ceram. Soc.* 45 (2025) 116962
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Biography

Pascal Marchet is professor of chemistry and materials sciences at "Université de Limoges, France" and member of the Institute of Research on Ceramics in Limoges (IRCER, UMR 7315 CNRS).

His activity is devoted to relationships between structure and properties of lead-free perovskite materials, mainly on ferroelectric – piezoelectric – dielectric properties.

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