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(54) Title: **IMPROVED METHOD OF ELECTROPHORETIC DEPOSITION OF FERROELECTRIC FILMS USING A TRI-FUNCTIONAL ADDITIVE AND COMPOSITIONS FOR EFFECTING SAME**

(57) Abstract: An improved method for depositing ferroelectric particles on a surface of a substrate to form films or stand-alone bodies. The improvement is based on electrophoretic deposition (EPD) of ferroelectric films by using a tri-functional phosphate ester additive having a concentration less than 10 volume percent in the EPD suspension, without the need for addition of a binder. The method includes preparation of the suspension by washing and dispersing ferroelectric particles, for example, commercially available PZT powder, in a polar solvent such as ethanol, followed by addition of the phosphate ester additive to the suspension, and an ultrasound treatment. The suspension is used in EPD of the ferroelectric particles on a prepared substrate. Following EPD, the green film is dried and sintered at high temperature. Visual and physical examination of stand alone and patterned PZT deposited films show excellent quality obtained in manufacturing a diversity of piezoelectric products, featuring exceptionally high green film uniformity, thickness distribution, and reproducibility to within ± 2 microns for 20 micrometer film thickness. The phosphate ester additive functions by improving stabilization and control of suspension characteristics and properties during the electrophoretic migration process, and by improving desired dimensions, characteristics, and electrical properties of the deposited green film. Thin or thick ferroelectric films, either as stand alone products, or formed on geometrically demanding patterned or non-patterned substrates are produced by using the method. The improved method is applicable to different ferroelectric particulate materials and to different substrates used for manufacturing piezoelectric elements and devices, in a cost effective manner.

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