Pyroelectric PZT/PMNZTU composite thick films

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Abstract

Uranium doped lead magnesium niobate - lead zirconate titanate (PMNZTU) composite thick films have been fabricated on silicon substrates using a composite sol gel technique. A slurry, made up of PMNZTU powder and PZT sol, was spun onto a silicon substrate and fired to yield a porous skeletal ceramic structure. Subsequent sol infiltration and pyrolysis was used to modify the density of the films prior to final sintering at 710ºC.

Pyroelectric and dielectric properties have been measured as a function of sol infiltration. The pyroelectric coefficients (p_{max} = 2.74 $Cm^{-2}K^{-1}$) of the composite thick films were found to be comparable to tape cast and monolithic ceramics of similar composition (2.8 & 3.0 $Cm^{-2}\,K^{-1}$ respectively).

Maximum figures of merit (F_V = 3.45 x 10^{-2} m^2C^{-1}, F_D = 1.01 x 10^{-5} $Pa^{-1/2}$), calculated using the electrical properties of the thick films, can be compared with those of screen printed thick films (F_V = 2.7–3.9 x 10^{-2} m^2C^{-1}, F_D = 0.8-1.1 x 10^{-5} $Pa^{-1/2}$) processed at temperatures of ca 1100ºC. The ability to directly integrate thick pyroelectric films onto substrates at temperatures as low as 710ºC, while maintaining competitive figures-of-merit is of considerable interest for future device applications.