BEHIND THE HIGH ELECTRICAL PERFORMANCE OF FLASH SINTERED POTASSIUM SODIUM NIOBATE PIEZOELECTRIC CERAMICS

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In view of sensor, actuator and energy harvesting applications, lead-free $K_{0.5}Na_{0.5}NbO_3$ (KNN) ceramics present such benefits as high ferroelectric transition temperature and elevated piezoelectric coefficient, if their content of secondary phases is diminished. Alternative sintering techniques, including electric field- and current-assisted Flash sintering, are promising for low thermal budget production of single-phase KNN ceramics, which electrical properties however have not been widely disclosed so far. Here, KNN ceramics Flash sintered at 900 ºC for 60 s only is successfully demonstrated to be of high performance. These ceramics with Pt electrodes cured at 900 ºC possess room-temperature remnant polarization P_r = 21 μC/cm^2 and longitudinal piezoelectric coefficient d_{33} = 117 pC/N, slightly superior to that for KNN ceramics conventionally sintered at 1125 ºC for 3 h (see Fig. 1) [1]. At the same time, since mechanisms of Flash and conventional sintering processes are dramatically different that affects the ceramic electrical performance. Systematic and comparative ferroelectric, dielectric permittivity, impedance spectroscopy and DC conductivity analysis shows that heat treatment, synergistically needed for the electrode curing and ceramic defect relaxation, is not less important than the low thermal budget Flash sintering process for potential applications of Flash KNN ceramics in innovative low-carbon technologies.

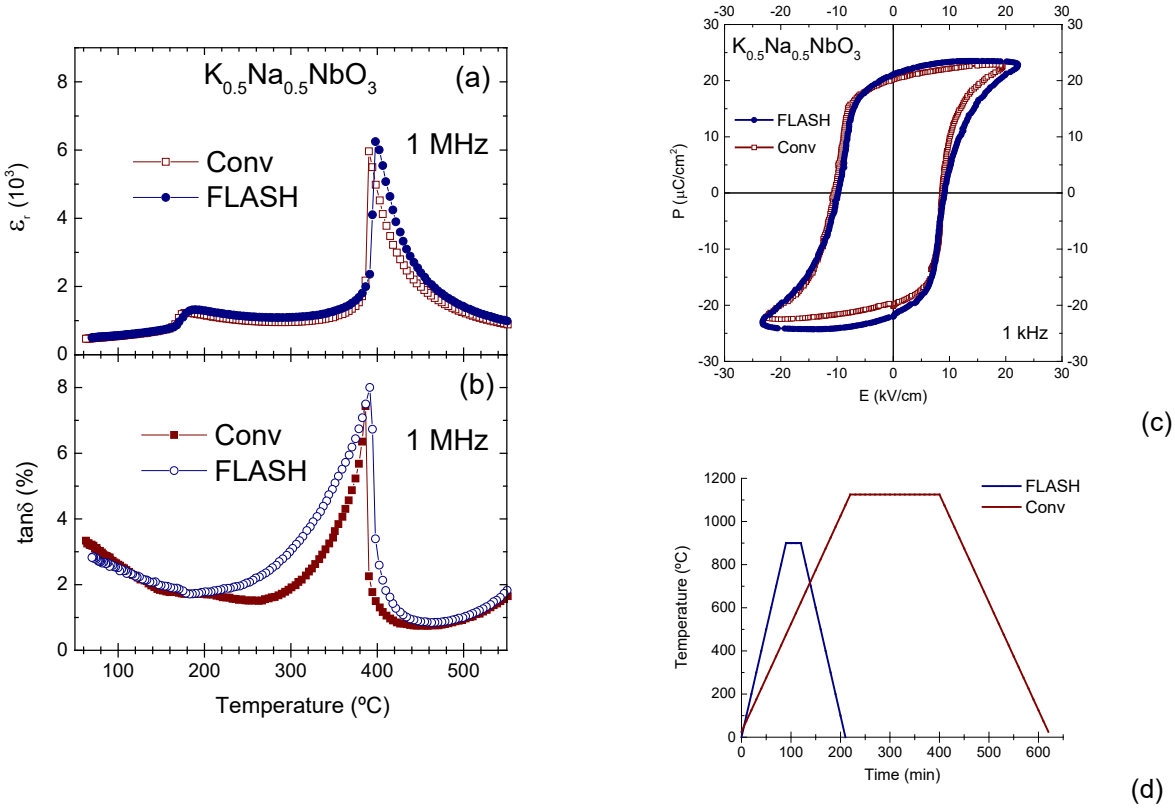

Figure 1 – a) Temperature dependence of real part of the dielectric permittivity (ε_r) and b) dissipation factor (tanδ), c) polarisation-electric field (P-E) hysteresis loops and d) thermal profiles used for sintering of KNN ceramics by conventional (Conv) and Flash processes.

[1] R. Serrazina, A. Tkach, L. Pereira, A.M.O.R. Senos, P.M. Vilarinho, *Materials* 15 (2022) 6603