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PII: S0955-2219(18)30109-2
DOI: https://doi.org/10.1016/j.jeurceramsoc.2018.02.026
Reference: JECS 11741

To appear in: *Journal of the European Ceramic Society*

Received date: 23-10-2017
Revised date: 15-2-2018
Accepted date: 17-2-2018

Please cite this article as: Liu Z, Fan H, Lu J, Mao Y, Zhao Y, Tailored dielectric tunability of alkali niobate-based antiferroelectric/relaxor-ferroelectric composites, *Journal of The European Ceramic Society* (2010), https://doi.org/10.1016/j.jeurceramsoc.2018.02.026

Tailored dielectric tunability of alkali niobate-based antiferroelectric/relaxor-ferroelectric composites

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High dielectric tunability, low loss and an appropriate level of dielectric permittivity are basic requirements of ferroelectric materials for tunable microwave devices. In this study, $0.96NaNbO_3$-$0.04CaZrO_3$/$0.88(K_{0.5}Na_{0.5})NbO_3$-$0.12SrZrO_3$, antiferroelectric/relaxor-ferroelectric composites were designed to tailor dielectric tunability. By tailoring the microstructure of the composites, a high dielectric tunability of 51.78% with a low loss of 0.015 was achieved at the composition ratio of 15/85. The nonlinear behaviours of the composites were explored by Johnson model; with increasing antiferroelectric phase, the contribution of the polarization to the free energy was increased between the antiferroelectric and relaxor-ferroelectric. Furthermore, the high resistance layer at the grain boundary region greatly inhibited the long-term migration of electrons and defective ions (mainly oxygen vacancies) in