Electrical and Thermal Characterization of (Ba, Sr)(Zr, Ti)O3 Ceramic Dielectrics for Applications in Nonlinear Capacitors*

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Resumo:
Dielectric ceramics with low dissipation factor and high permittivity used for constructing nonlinear capacitors are useful in devices for generating RF as nonlinear transmission lines (NLTLs) applied in mobile defense platforms or pulsed radars in remote sensing. The main characteristic of these dielectric ceramics is the permittivity variation with the electric field and temperature, providing the nonlinear property of the material for the NLTL device. We used barium titanate ($BaTiO_3$) in this application [1] in the past. However, this pure composite presents the nonlinearity in the paraelectric phase above the 120° Celsius Curie temperature. Thus, a search for new ceramic materials has been investigated [2]. Then, in this work, to decrease the paraelectric to ferroelectric phase transition near room temperature and improve the nonlinear characteristics of the ceramic material, we synthesized and characterized the (Ba,Sr)(Zr,Ti)O3 ceramics for applications in NLTLs as nonlinear elements. We investigated the electrical permittivity behavior of this material by varying the applied electric field and frequency at room temperature. Also, the permittivity versus temperature measured identified the paraelectric phase transition of this ceramic composite. The results show that the new material obtained can be used in NLTL applications with superior performance than the BaTiO3. [1] L. P. Silva Neto, J. O. Rossi, J. J. Barroso, and E. Schamiloglu, "High-Power RF Generation from Nonlinear Transmission Lines with Barium Titanate Ceramic Capacitors," in IEEE Transactions on Plasma Science, vol. 44, no. 12, pp. 3424-3431, Dec. 2016, DOI: 10.1109/TPS.2016.2628324. [2] R.G. Aredes, E. Antonelli, L.P. Silva Neto, J.O. Rossi, and E. Schamiloglu, “Tunability Behavior of (Ba,Ca)(Zr, Ti)O3 Ceramic Capacitors Powered by Thermally Induced Phase Transitions with Applications to Nonlinear Transmission Lines,” Paper submitted to the Transactions on Plasma Science, April 2022. * Work supported by FAPESP and SOARD/AFOSR under contract no. 2020/04395-3 and FA9550-18-1-0111, respectively.