

The Influence of Mechanical Activation on the Electrical Properties of $\text{Ba}_{0.77}\text{Sr}_{0.23}\text{TiO}_3$ Ceramics

D. Kosanović^{1*}, J. Živojinović¹, N. Obradović¹, V. P. Pavlović²,
V. B. Pavlović¹, A. Peleš¹, M. M. Ristić³

¹Institute of Technical Sciences of the Serbian Academy of Sciences and Arts,
Knez Mihailova 35/IV, 11000 Belgrade, Serbia

²Faculty of Mechanical Engineering, University of Belgrade, Belgrade, Serbia

³Serbian Academy of Sciences and Arts, Knez Mihailova 35, 11000 Belgrade, Serbia

Abstract

Ferroelectric ceramic barium strontium titanate ($\text{Ba}_{0.77}\text{Sr}_{0.23}\text{TiO}_3$), BST, was prepared by solid-state reactions using starting powders of barium carbonate (BaCO_3), strontium carbonate (SrCO_3) and titanium dioxide (TiO_2 -anatase). Non-activated and mechanically activated mixture of high-energy planetary ball mill (0, 5, 10, 20, 40, 80 and 120 minutes) were sintered at 1100, 1200, 1300 and 1400 °C for 2 h in air. The maximum value of ceramic density is about 86.20% TG. Defects and the beginning of sintering process on the microstructure was investigated by scanning electron microscopy (SEM). Electrical measurements (loss tangent of the angle and influence the activation time dependence of $X_c=f(\log \nu)$) are made of ceramics sintered at 1400 °C for 2 h.

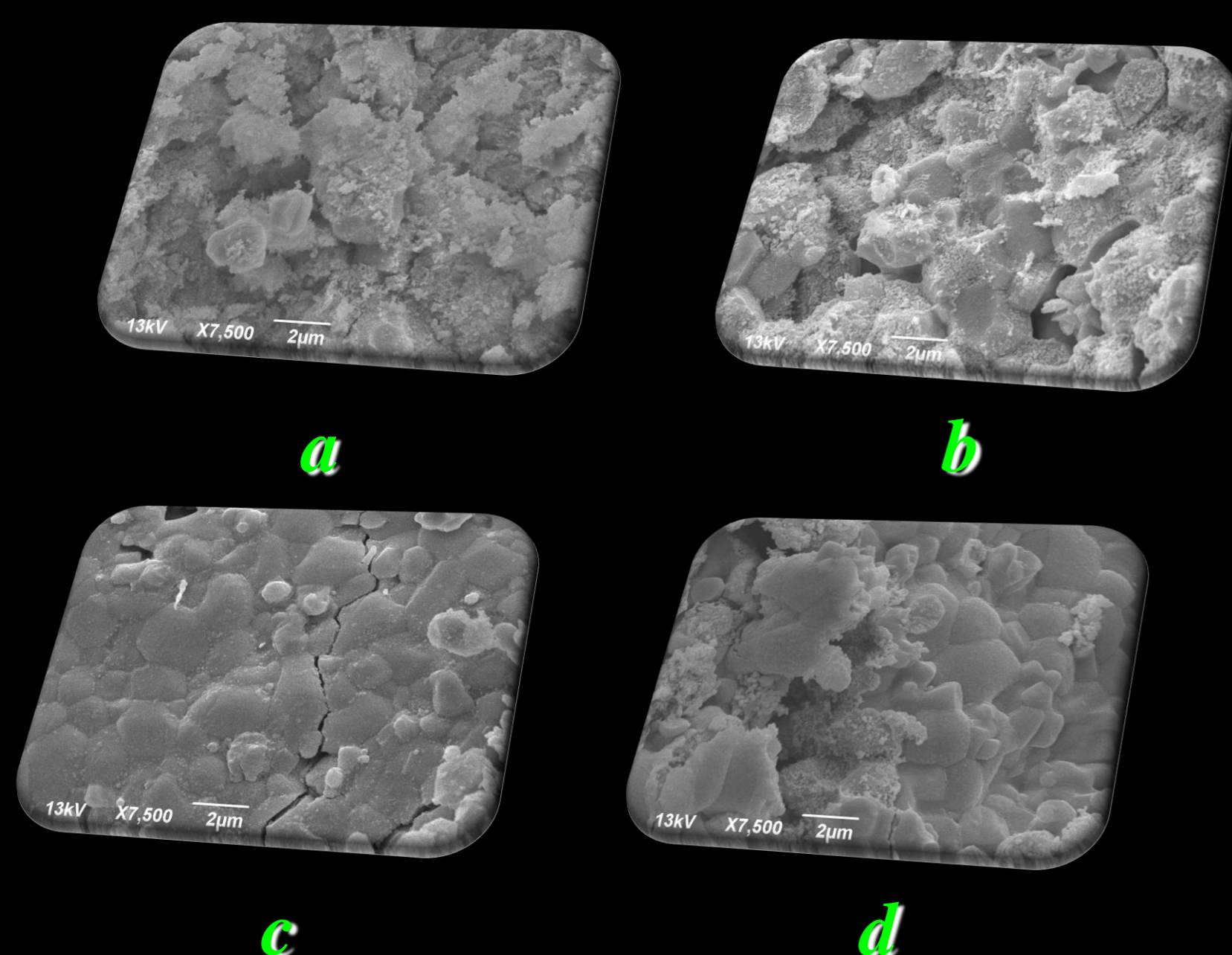


Fig. 1. Scanning electron micrographs of: a) BST-S-0, b) BST-S-20, c) BST-S-80 and d) BST-S-120 sintered at 1400 °C for 2h

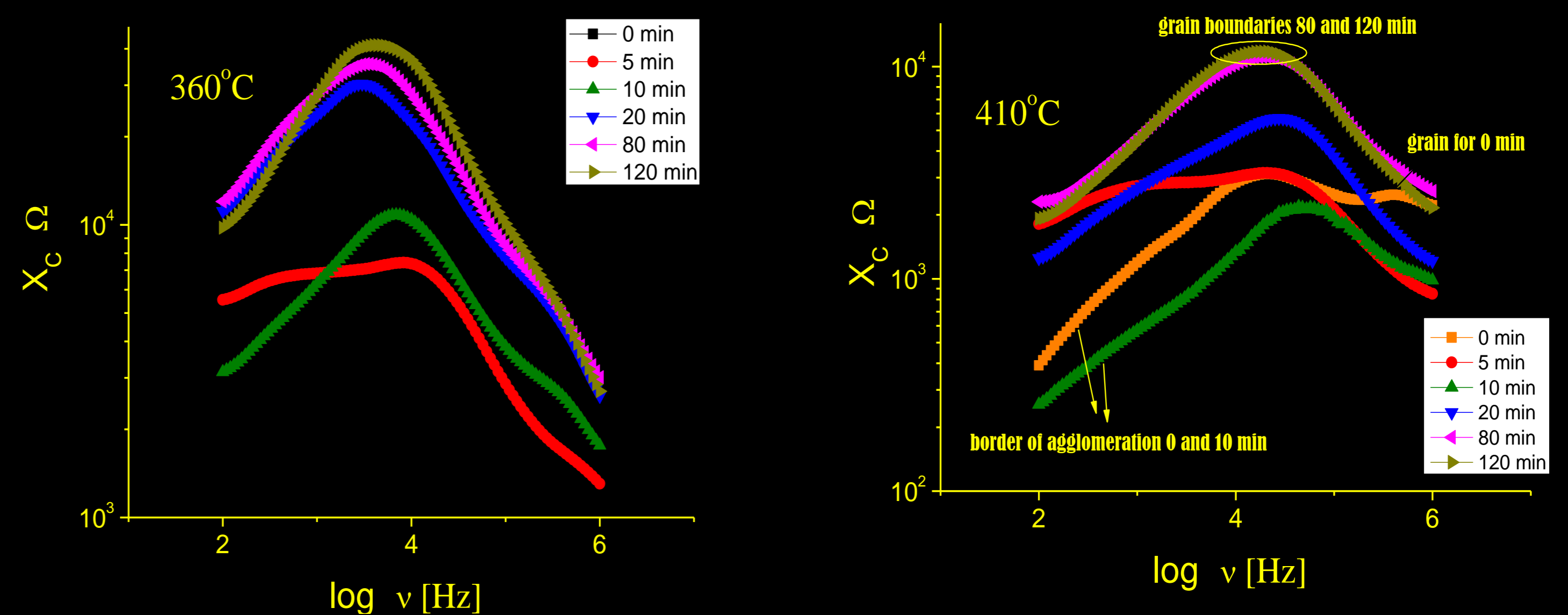


Fig. 2. Influence activation time dependence: $X_c=f(\log \nu)$ at a temperature of 360 °C and 410 °C

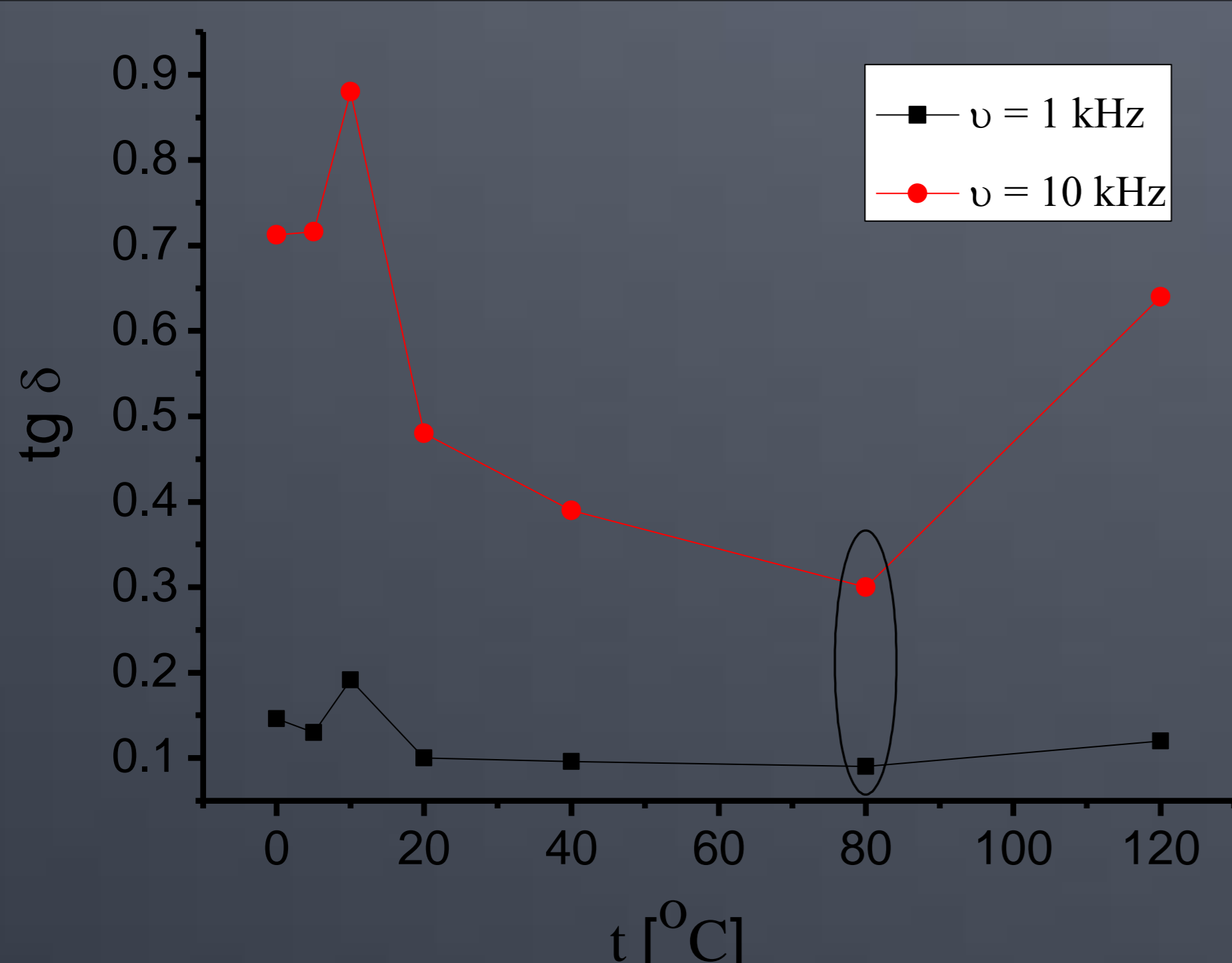


Fig. 3. Influence of activation time on temperature-dependence of the dielectric losses of BST-S sintered samples at frequencies of 1 kHz and 10 kHz.

Conclusion

- In this paper, the influence of mechanical activation on the electrical properties of $\text{Ba}_{0.77}\text{Sr}_{0.23}\text{TiO}_3$ ceramics was investigated.
- Also, the mechanical activation of the starting powder for 120 min can reduce the sintering temperature of around 100 °C, which leads to significant energy savings.
- From the point of dielectric loss was found that the optimal duration of mechanical activation of starting powders is 80 minutes.
- Samples of the powder sintered at 1400 °C for 2 h with about 36% lower dielectric loss at a frequency of 1 kHz and about 57% at a frequency of 10 kHz of the samples obtained from the initial non-activated powder sintering under the same conditions.
- With the increase in temperature alters the relative ratio of the contribution of the resistance of the grain and grain boundaries on the side of the grain boundary.