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A nonlinear analysis of the transport Barkhausen-like noise measured in $(Bi,Pb)_2Sr_2Ca_2Cu_3O_{10+\delta}$ superconductors

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ABSTRACT

We investigated the transport Barkhausen-like noise (TBN) by using nonlinear time series analysis. TBN signals were measured in $(Bi,Pb)_2Sr_2Ca_2Cu_3O_{10+\delta}$ ceramic samples subjected to different uniaxial compacting pressures (UCP). These samples display similar intragranular properties but different intergranular features. We found positive Lyapunov exponents in all samples, $\lambda_m \geq 0.062$, indicating the nonlinear dynamics of the experimental TBN signals. It was also observed higher values of the embedding dimension, $m > 9$, and the Kaplan-Yorke dimension, $D_{KY} > 2.9$. Between samples, the behavior of λ_m and D_{KY} with increasing excitation current is quite different. Such a behavior is explained in terms of changes in the microstructure associated with the UCP. In addition, determinism tests indicated that the TBN masked determinist components, as inferred by $\left|\vec{k}\right|$ values larger than 0.70 in most of the cases. Evidence on the existence of empirical attractors by reconstructing the phase spaces has been also found. All obtained results are useful indicators of the interplay between the uniaxial compacting pressure, differences in the microstructure of the samples, and the TBN signal dynamics.

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