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$Bi_{0.5}Na_{0.5}TiO_3$-$BaTiO_3$-$K_{0.5}Na_{0.5}NbO_3$:ZnO relaxor ferroelectric composites with high breakdown electric field and large energy storage properties

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$0.82[0.94Bi_{0.5}Na_{0.5}TiO_3$-$0.06BaTiO_3]$-$0.18K_{0.5}Na_{0.5}NbO_3$:$x$ZnO (BNT-BT-KNN:$x$ZnO, x = 0-0.40) relaxor composites were prepared and their electrical properties were investigated. The breakdown electric field increases with increasing ZnO content. For x = 0 and x = 0.40 samples, the maximum recoverable energy storage density is 0.74 J/cm^3 and 1.03 J/cm^3 while the maximum energy storage efficiency is 86.7% and 72.7% under the electric field of 9.0 kV/mm and 14.0 kV/mm, respectively. The recoverable energy storage density and efficiency of the composite vary less than 2.5% from 25°C to 125°C, which indicates temperature-insensitive energy storage performance. These results are discussed based on the ZnO-enhanced bulk resistivity and the ZnO-induced local electric field which suppresses the evolution of polar nanoregions.

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