

Nanocomposite Solid Materials for Novel Biomechanical Energy Harvesting and Dielectric Cooling

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The request for greener heat-management technologies has recently developed a significant interest in new electrocaloric effect (ECE)-based dielectric cooling devices that can replace the existing cooling techniques [1]. An overview of experimental and theoretical investigations of the large ECE and piezoelectric response in ferroelectric lead-free ceramic composites, thin films, and ceramics near antiferroelectric transition will be presented in this contribution. Specifically, the large ECE response observed by direct experiments in lead-free BCTZ-based ceramics will be reviewed, including biocompatible polymer composites' large energy harvesting potential [2]. It will be shown that in thin ferroelectric films, the ECE could exceed 40 K. Besides, it is demonstrated that negative and positive EC responses can be arbitrarily invoked in antiferroelectric materials by adequately controlling the electric field and temperature, which enables electrocaloric cooling power enhancement for up to 100%.

References

1. Z. Kutnjak, B. Rozic, R. Pirc., Wiley Encyclopedia of Electrical and Electronics Engineering, 1-19 (2015).
2. Z. Hanani et al., Nano Energy 81, 105661 (2021).