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A Flexible Multiferroic Composite with High Self-biased Magnetoelectric Coupling

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Abstract

Polymer-matrix multiferroic composites with self-biased magnetoelectric (ME) coupling hold promises in flexible energy harvester, magnetic field sensors and actuators, etc. Using CoFe_2O_4 (CFO) nanoparticles and multi-walled carbon nanotubes (CNTs) as fillers to the polyvinylidene fluoride (PVDF) matrix, piezomagnetic films (CFO-CNT-PVDF, also named as M layers) with different volume fractions of CFO and a fixed percentage of CNTs are obtained, which also serve as the electrode. By employing the layer of poly(vinylidene fluoride-trifluoroethylene) (P(VDF-TrFE), named as P layer) sandwiched between the two conductive layers of CFO-CNT-PVDF, and followed by hot-pressing, three-layered multiferroic composite CFO-CNT-PVDF/P(VDF-TrFE)/CFO-CNT-PVDF (named as $M/P/M$) are prepared. The ME coupling increases with the volume fraction of CFO nanoparticles. The maximum self-biased and peak values of ME coefficient (α_{ME}) reach $16.7 \text{ mV}\cdot\text{cm}^{-1}\cdot\text{Oe}^{-1}$ and $25.8 \text{ mV}\cdot\text{cm}^{-1}\cdot\text{Oe}^{-1}$, respectively. Measurements on the relationship between the magnetostriction and static magnetic field (H_s) are performed for the CFO-CNT-PVDF films with different volume fraction of CFO. Based on the equivalent circuit model, the self-biased and peak values of α_{ME}

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