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All-printed magnetoelectric materials

Two decades ago, the "polymer based magnetoelectric"idea changed thinking in magnetoelectric (ME) materials scientific community, which led to a new generation of high-performance materials and an increased focus on controlling structure, flexibility, and electrical output, as well as in the implementation into proof-of-concept applications1.
Nowadays, the successful implementation of those materials is closely related to the processing and integration of ME materials by additive manufacturing techniques 2.
Here a novel screen printed (Figure 1a), and flexible ME material is developed based on poly (vinylidene fluoride-co-trifluoroethylene) (PVDF-TrFE) as the piezoelectric phase and poly (vinylidene fluoride) (PVDF)/CoFe2O4 as the magnetostrictive phase. The all-printed ME composite exhibits a ferromagnetic behavior with ≈16 emu. g-1 saturation magnetization, ≈ -26 pC. N-1 piezoelectric response and a ME voltage coefficient (α) of ≈160 mV.cm-1. Oe-1 at the resonance frequency of ≈ 16 kHz (Figure 1b)3. Such optimized magnetic, piezoelectric and ME behavior associated to the reduced cost of assembly, easy integration into devices and the possibility to be obtained over flexible and large areas trough screen printing demonstrates the suitability of the developed material for applications in areas such as printed electronics, sensors, actuators, and energy harvesters.

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