Non-resonant Magnetoelectric Energy Harvester

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Recent advances in phase transition transduction enabled the design of a non-resonant broadband mechanical energy harvester that is capable of delivering energy density per cycle ~10^3 larger than the resonant cantilever piezoelectric type. The basic idea here is to mechanically bias the crystal to a state just below the ferroelectric rhombohedral F_R-ferroelectric orthorhombic F_O phase boundary in a domain engineered [011] oriented and poled, relaxor-ferroelectric single crystal. Therefore, small variation in an input parameter, e.g., electrical, mechanical, or thermal will generate a large output due to the significant polarization change associated with the transition. We extended this idea to design a non-resonant, magnetoelectric composite harvester comprised of a highly magntostrictive $Fe_{81}Ga_{19}$ (Galfenol) alloy and lead indium niobate–lead magnesium niobate–lead titanate (PIN-PMN-PT) domain engineered relaxor ferroelectric single crystal. We demonstrated high energy conversion by triggering the F_R- F_O transition in the single crystal by a small time varying magnetic field in a broad frequency range that is important for multimodal energy harvesting devices [1].

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