Supplementary Information (SI) for Journal of Materials Chemistry C.

Support Information

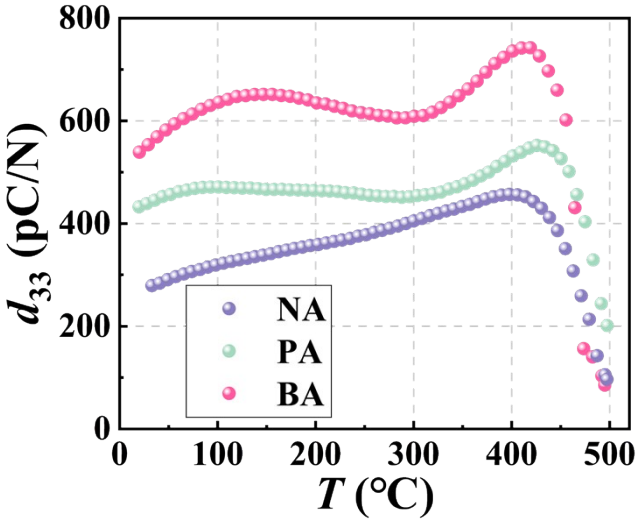

Fig. S1 *In-situ* variable temperature d_{33} of the the NA-BSPT, PA-BSPT and BA-BSPT samples.

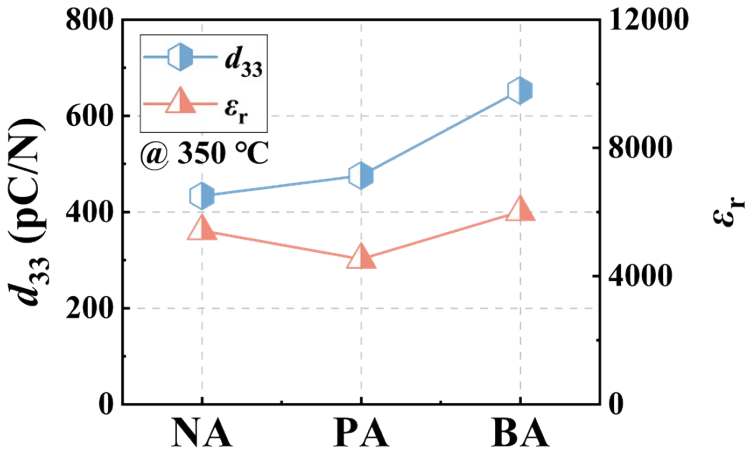

Fig. S2 d_{33} and ε_r values of the NA-BSPT, PA-BSPT and BA-BSPT samples at 350 °C.

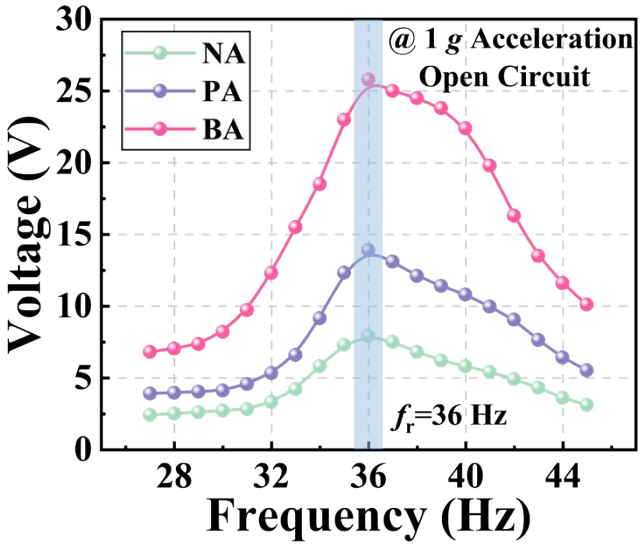

Fig. S3 Output voltage of PEHs constructed by the NA-BSPT, PA-BSPT and BA-BSPT samples varies with frequency.

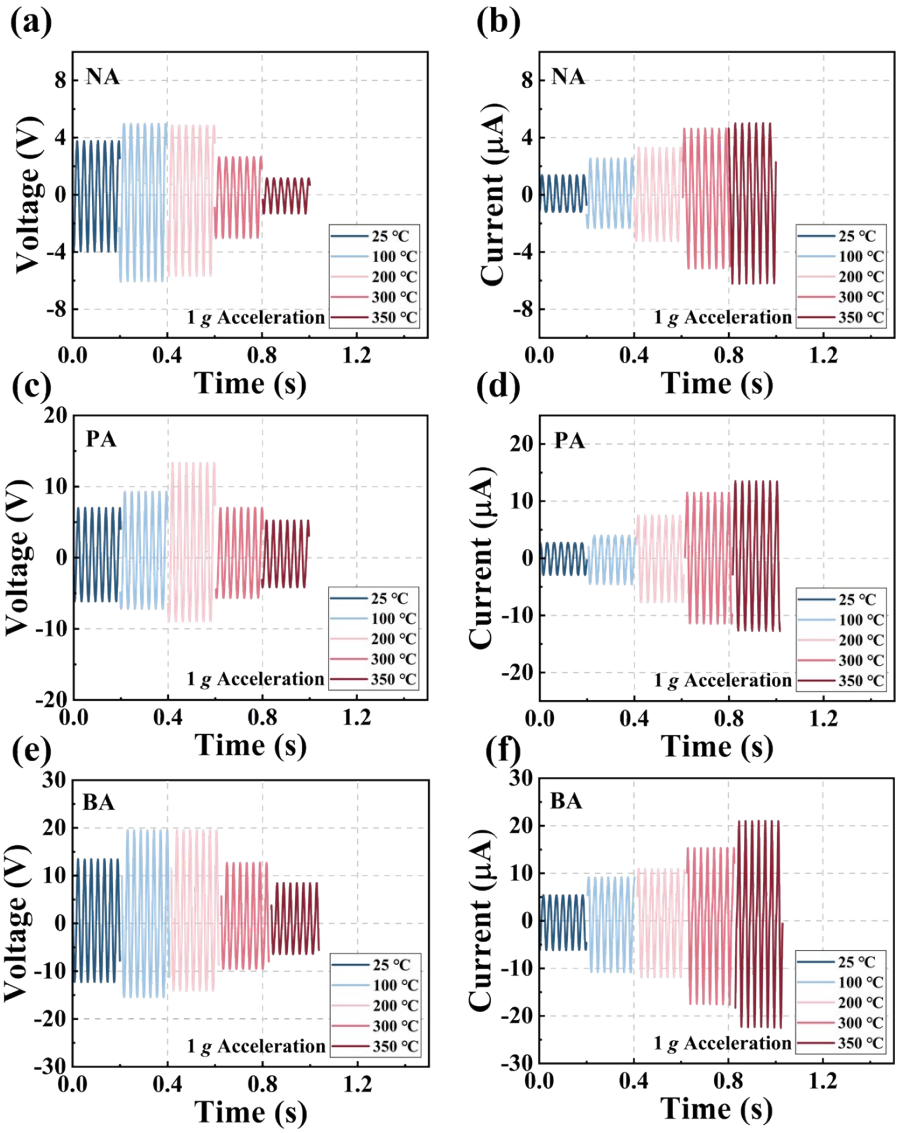

Fig. S4 V_{open} and I_{sc} measured at different temperatures for the (a, b) NA-BSPT, (c, d) PA-BSPT, and (e, f) BA-BSPT samples.

Table S1. Lattice parameters obtained from the Rietveld structural refinement

Sample	Space group	Lattice paramaters			Cell volume ($Å^3$)	Phase content (%)	R_{wp} (%)	R_p (%)	R_{epx} (%)
		a (Å)	*b* (Å)	*c* (Å)					
NA-BSPT	*P*4*mm*	4.005	4.005	4.086	65.553	46	6.36	4.10	1.35
	*R*3*m*	4.041	4.041	4.041	65.983	54			
PA-BSPT	*P*4*mm*	3.996	3.996	4.088	65.258	54	9.61	6.11	1.42
	*R*3*m*	4.039	4.039	4.039	65.919	46			
BA-BSPT	*P*4*mm*	3.997	3.997	4.085	65.261	66	9.86	6.47	1.42
	*R*3*m*	4.034	4.034	4.034	65.662	34			

Table S2. Related parameters for Gibbs free energy calculations

α_{ijk} coefficient	Formulas and values
α_1	$\alpha_1(T)=\frac{T-T_0}{2\varepsilon_0 C}$
α_{11}	$3.614\times10^{7}\mathrm{m}^5/\mathrm{C}^2\mathrm{F}$
α_{12}	$3.233\times10^{8}\mathrm{m}^5/\mathrm{C}^2\mathrm{F}$
α_{111}	$1.859\times10^{8}\mathrm{m}^9/\mathrm{C}^4\mathrm{F}$
α_{112}	$5\times10^{8}\mathrm{m}^9/\mathrm{C}^4\mathrm{F}$
α_{123}	$-3.5\times10^{9}\mathrm{m}^9/\mathrm{C}^4\mathrm{F}$

Table S3. Raw ICP-OES measurement data for the NA-BSPT, PA-BSPT, and BA-BSPT ceramics

Sample	Element	Spectral line (nm)	Measured concentration (mg/L)
BA-BSPT	Pb	220.353	11.320
	Bi	223.061	6.598
PA-BSPT	Pb	220.353	11.207
	Bi	223.061	5.938
NA-BSPT	Pb	220.353	9.622
	Bi	223.061	5.839

Table S4. Geometric dimensions and boundary conditions of the two-segment cantilever beam and tip mass assembly used in the simulation

Component	Geometric dimensions (mm)	Boundary conditions / Loads
Beam segment 1	205×12×2 (L×w×t)	Fixed constraint applied at 42 mm from the root
Beam segment 2	45×12×0.5 (L×w×t)	Boundary load: A surface force equivalent to 1 g acceleration applied to the tip vertical face
Tip mass blocks	R_{out}=5, R_{in} =2, h=2 (Ring-shaped)	
Screw & Nut	Screw head: R=5, h=2 Thread: R=2, h=10 Nut: R=3.5, h=2	