Electronic Supplementary Material (ESI) for Energy Advances.

High performance piezoelectric-triboelectric hybrid energy harvester by synergistic design

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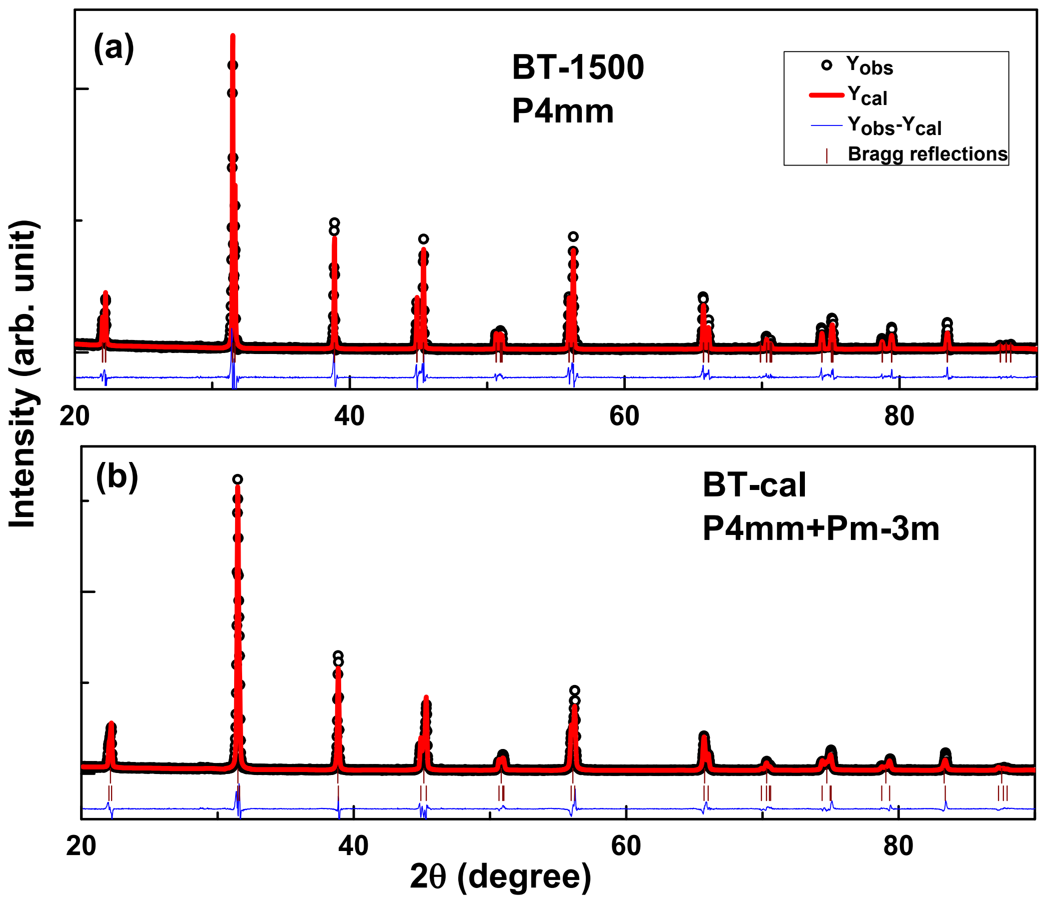

Figure S1: Rietveld refinement of the X-Ray powder diffraction (XRPD) patterns of different $BaTiO_3$ specimens – (a) BT-1500 with P4mm space group and (b) BT-cal with P4mm + Pm-3m phase coexistence model. In the figure Yobs implies data points, Ycal signifies calculated pattern using respective space group model and Yobs – Ycal indicates difference plot among observed and calculated patterns.

Table. S1: Refined structural parameters of X-Ray powder diffraction data of BT-1500. Numerical values inside brackets of all the parameters indicate error in the refined value.

Tetragonal (P4mm) structural parameters of BT-1500				
Atomic Coordinates	x	y	z	Isotropic Thermal Parameters (Å^2)
Ba	0	0	0	0.02(0)
Ti	0.5	0.5	0.476(3)	0.03(0)
O1	0.5	0.5	0.012(0)	1.0(0)
O2	0.5	0	0.520(0)	1.0(0)
a =b= 3.9947(1) Å; c = 4.0348(5) Å; Rp = 9.03; Rwp =11.6; Rexp = 9.43; χ^2 = 3.81				

Table. S2: Refined structural parameters of X-Ray powder diffraction data of BT-cal. Numerical values inside brackets of all the parameters indicate error in the refined value.

Tetragonal (P4mm) structural parameters of BT-cal				
Atomic Coordinates	x	y	z	Isotropic Thermal Parameters (Å^2)
Ba	0	0	0	0.125(0)
Ti	0.5	0.5	0.526(9)	0.125(0)
O1	0.5	0.5	0.014(0)	1.0(0)
O2	0.5	0	0.590(0)	1.0(0)
a =b= 3.9992(1) Å; c = 4.0329(5) Å; Rp = 7.79; Rwp =11.7; Rexp = 5.33; χ^2 = 4.82; Phase fraction %=55.22(5)				
Cubic (Pm-3m) structural parameters of BT-cal				
Atomic Coordinates	x	y	z	Isotropic Thermal Parameters (Å^2)
Ba	0	0	0	0.36 (0)
Ti	0.5	0.5	0.5	0.08(7)
O	0.5	0.5	0	1.0(0)
a =b=c= 4.0138(2) Å; Phase fraction %=44.78(9)				

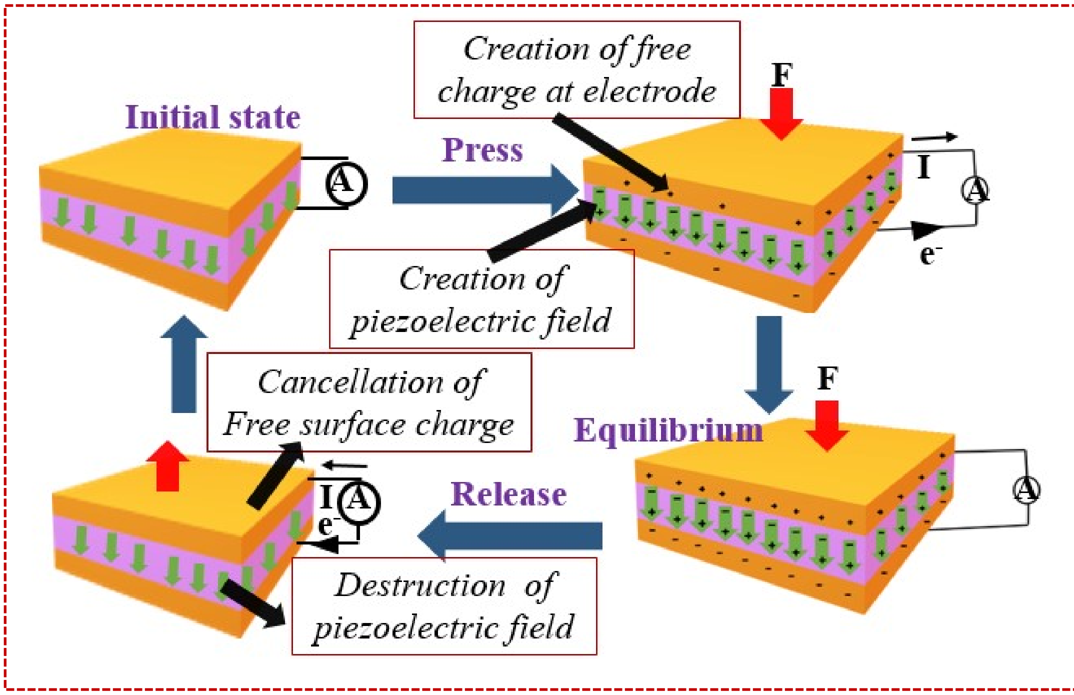

Figure S2: Mechanism of energy generation by mechanical impact on the PEH device shown schematically.

Table. S3: Comparison of electrical output performance of hybrid (TEH + PEH) mechanical energy harvesters from literatures. Emphasize is given to the nature of the composite in the hybrid device.

Ref. no.	Device structure	Active material/ Surface modification type	Voltage	Current
1	PVDF hollow pipe with PDMS valve	Nanoporous PVDF hollow pipe	105.5 V	16.7μA
2	Rectangular	$BaTiO_3$/PDMS/ plain surface	60 V	1 μA
3	Rectangular	PVDF/PANI composite with large pores inside	246V	122μA
4	Cantilever resonator	$BaTiO_3$/PDMS/ microroughness (sandpaper template)	14 V	4.5 μA
5	Spring type contact-separation	$Ti_{0.8}O_2$ nanosheets silver nanoparticles co-doped $BaTiO_3$/PDMS/ plain surface	150 V	0.03 μA
6	C-shaped	PDMS/micropatterned PCB/NMF	150 V	3.8 μA
7	Planar device-Electrospun	Electrospun PVDF fibers	210 V	45 μA
8	Planar device	Porous PVDF film	200 V	0.5 μA
9	Planar deice	ZnO/ Paper/ PMMA	38.4 V	1.3 μA
This work	Planner device	Grain size enhanced BaTiO3/PDMS	100 V	2 μA

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