Supporting Information

Power generation for wearable systems

*Mingyuan Gao, Ping Wang, Lili Jiang, Bowen Wang, Ye Yao, Sheng Liu, Dewei Chu, Wenlong Cheng, and Yuerui Lu**

Table S1. Summary and comparison of various electrostatic energy generator.

Generator Type	Electret Materials	Generator volume [mm^3]	Proof Mass [g]	Input Amplitude [mm]	Input Frequency [Hz]	Z_{p-p} /Z_{max} [mm]	Power [μW]	Theory Maximum Power [μW]	Effectiveness [%]	Volume Figure of Merit [%]	Reference
In-plane Overlap Varying	CYTOP	18.5×16.5×1	0.4	0.15	40-70/1*g*	1.8 (Z_{p-p})	4.0	427.98	0.935	0.06786	[159]
In-plane Overlap Varying	SiO_2	20×45×2.5	6	25	2/0.4*g*	15	40	2232	1.79	2.27	[160]
In-plane Overlap Varying		20×20×4	3.7	0.0416	30/0.15*g*	2 (Z_{p-p})	100	514.64	19.43	1.59	[161]
In-plane Overlap Varying	No Electrets	11×6.5×0.86	0.0461	0.001	250/0.25*g*	0.1 (Z_{p-p})	0.061	4.46	1.367	5.38E-03	[162]
In-plane Overlap Varying	CYTOP EGG	Ø39×3.3			1-2 rps		80				[163]
In-plane Overlap Varying	Parylene HT	50000	0.3564	0.1	50	1 (Z_{p-p})	17.98	275.85	6.52	2.61E-04	[164]
Finger-tapping	Parylene C	$\pi \times 7^2 \times 2$		18.5 cm/s			312.7				[165]
In-plane Overlap Varying	CYTOP	200	0.061	4.7nm	368.5-376.45	0.008 (Z_{max})	0.2nW	0.0144	1.39	2.4E-04	[166]
In-plane Gap Closing	No Electrets	4×5×0.025	0.00092	0.000294	712/0.6*g*	0.0055 (Z_{max})	17nW	0.0847		2.911	[167]

Finger-tapping	PVDF/PTFD, Parylene C	25×25×2			10	1-2 (Z_{max})	45.6				[168]
In-plane Overlap Varying	No Electrets	200	0.000642	0.0015	1300-1500(1460)/13*g*	0.02 (Z_{max})	3.5/1.58	7.42	21.29	9.69E-05	[169]
Out-of-plane Gap Closing	Teflon	32×9×10	3	0.0247	45/0.2*g*	0.046 (Z_{p-p})	17	19.232	88.39	0.0617	[170]
In-plane Gap Closing	No Electret		4	0.004	120/0.23*g*	0.0254 (Z_{max})	1.2	86.965	1.38		[171]
In-plane Overlap Varying	No Electret	39.375	0.0079	0.01574	63/0.25*g*	0.0036	0.39				[172]
In-plane Overlap Varying	No Electret	1000		25	1.5		0.3				[173]

Table S2. Summary of comparison of various electromagnetic energy generator.

Generator Type	Generator volume [mm^3]	Pro of Mass [g]	Input Amplitude [mm)]	Input Frequency [Hz]	Z_{p-p} /Z_{max} [mm]	Number of coils	Output Voltage [V]	Power [μW]	Theory Maximum Power [μW]	Effectiveness [%]	Volume Figure of Merit [%]	Reference
Cantilever-resonant	8000	0.58	0.0147	130/1.0*g*		2100	1	422		55.5	0.027	[217]
Diaphragm-resonant	600	0.0465	0.0488	54/0.57*g*	4 (Z_{max})	183	0.0682	115.1	176.96	65.03	0.991	[218]
Non-resonant	1700	0.21	0.2968	40-80/1.9*g*	2 (Z_{max})	10×12	0.009 (V_{max})	0.4	987.97	0.0405	3.47E-04	[219]
Tunable Cantilever-resonant	2400	2.4	0.00328	67.6-98/0.06*g*	1.2 (Z_{p-p})	6950	8.1	61.6	180.14	34.09	0.633	[220]
Pendulum-resonant	100878 (46×43×51)	120	0.04325	17/0.05*g*	5 (Z_{max})	1500	1.5 (V_{max})	5000	15788.22	31.67	1.677	[221]
Hybrid Up-conversion	148.75 (8.5×7×2.5)	0.16	0.44-2	70-150 (113)	0.2 (Z_{max})	6	0.57E-03	0.25E-03	2515.86	1.987E-04	3.34E-06	[222]
Hybrid Up-conversion	456	1.6	0.001	3400	0.15 (Z_{max})	16	0.67E-03	56pW				[223]
Diaphragm-	130	0.0312	0.125	55/1.5*g*	0.2591 (Z_{max})	60	0.018 (V_{pp})	0.61	20.819	2.93	0.0149	[224]

resonant												
Translation-resonant	8586	7	16	5/	50 (Z_{max})	500	0.1-0.25	3000	86685.6	3.46	2.86	[225]
Hybrid Cantilever-resonant	93750 (25×30×125)	17.6	21.88	20/35*g*	10 (Z_{p-p})	500		0.25 W	1.90752W	13.106	0.112	[226]
Beam-resonant	3375	0.26	0.014	938	0.4 (Z_{max})	20×2	1E-04	3.2	148805	2.15E-03	1.83E-06	[227]
Tunable Cantilever-resonant	150/11760	1.02	0.00564	52/0.061*g*	0.85 (Z_{max})	2800	1.141 (V_{rms})	58	85.144	68.12	30.716	[228]
Hybrid Stroke-non-resonant	141.3 (Ø6×5)	0.26	2	3-8	2 (Z_{max})	300	0.0122	1.15	65.94	1.74	0.51	[229]
Translation-resonant	12700	27	0.15	8/0.0385*g*	4-8 (Z_{max})	1000	2 (V_{max})	300	1027.15	29.2	4.41	[230]
Cantilever-resonant	150	0.54	0.06215	60/0.895*g*	1.5 (Z_{max})	65	0.0235 (V_{pp})	0.584	1346.57	0.0434	0.0183	[231]
Cantilever-resonant	150	0.66	0.00554	52/0.06*g*	1.52 (Z_{max})	2300	0.428 (V_{rms})	46	96.773	47.53	24.8	[232]
Translation-resonant	500/30400	1.37		5-15	1.8 (Z_{max})	9250	2 (V_{max})	35				[233]
Swing-resonant	56422 (Ø25×115)	91.5	0.007	39.5/0.0435*g*	0.35 (Z_{max})	4760		320	1710.91	18.7	0.115	[234]
Up-conversion	68000	159.1	3.4376	2/0.055*g*	10 (Z_{max})		0.2 (V_{max})	57/2.3	5418.32	1.052	0.25	[235]
Rotating-non-resonant	2000	3.2	3.75	10/1.5*g*		4	0.137 (V_{rms})	117			0.414	[236]
Diaphragm-resonant	648	0.21	0.015	390/9*g*	0.1 (Z_{max})	300	0.07 (V_{max})	5	2313.95	0.216	3.35E-04	[237]
Diaphragm-resonant	14.3	0.055	0.00089	530/1*g*	0.01 (Z_{max})	3	13.2E-06 (V_{rms})	23pW	9.025	2.55E-04	1.674E-06	[238]
Up-conversion	3680	9.63	2.5	10/1*g*	2 (Z_{max})	2000	0.1 (V_{max})	558/39.5	5962.73	9.358	1.315	[239]
Hybrid Beam-resonant		0.836	0.000463	753/1.05*g*	0.035 (Z_{max})	750		30	716.29	4.188		[240]
Diaphragm-resonant	410	5.4	0.0854	24.2/0.2*g*	1 (Z_{max})	741	2E-03 (V_{max})	144	809.369	17.79	13.075	[241]

Table S3. Summary of comparison of various piezoelectric energy generator.

Generator volume [cm^3]	Mass [g]	Input amplitude [μm]	Excitation acc. [*g*]	Frequency [Hz]	Z_l [μm]	Power [μW]	Power density [$\mu W\ cm^{-3}$]	Effectiveness [EH%]	Merit [FoM_V %]	Reference
0.464	2.95	8.6	0.2	76	395.4	14	30.17	2.56	0.345	[258]
1.2	9	2480	1	10		3.25	2.7		0.0343	[259]
0.0266	0.21	7.92	5	400		42	1579		0.349	[260]
5.44E-04	0.00126	0.34	1	853	129	0.18	38.3	4.23	0.642	[261]
5.25E-03	0.024	13.7	5	304	644.1	17	3238	2.30	1.618	[262]
0.242	2.98	45.5	0.75	64	200	350.9	1450	3.98	6.520	[263]
19.25E-03	0.00049	13.43	0.25	68		0.023			0.035	[264]
5.60E-03	0.043	7.98	0.5	126	1.12E+03	5.3	946.4	5.57	11.158	[265]
7.4175E-04	0.16		0.16	6		284		65		[266]
1.00E-01	3.17	1.375	0.2	190	2.75E+01	49.5	495	48.5	3.779	[267]
1	16.8	7.5	0.23	87	300	370	268.1	12	2.504	[268]
37.32E-03	0.12	73.4	3	100.8		321	8664		9.303	[269]
7.69E-04	0.00142	5.5	0.75	183.8	2193.4	0.32	416	1.94	4.445	[270]
4.25E-04	0.00199	9.48	2.5	255.9		2.765	6513.5		18.233	[271]
0.175	1.56	5.53	0.26	108	138.3	50	285.7	26.8	2.451	[272]
0.033	0.077	4.1	1.75	325	675	85	2500	9.37	1.907	[273]
2.45E-04	0.00026	0.323	0.816	792		1.3			17.662	[274]
4.18E-4	0.00084	2.26	1.5	406		7.182	17181.8		50.765	[275]
0.054	1.0422	4.4	0.25	120		145	2680		31.228	[276]
0.0127	0.03	3.03	2	571	895	60	4724	3.19	1.120	[277]
4.006E-04	0.00289	0.94	1.0	514.1		11.56	28856.7		40.731	[278]
6.52E-04	0.00142	2.33	2	461.15	898	2.15	3272	5.95	5.562	[279]
5.12E-04	0.00117	1.13E-02	2	1495		0.45	878.9		9.725	[280]
2.3				3			8.22			[281]
1.06E-01	0.486	8.16E-02	1	1744	1.85	14.7	138	30.4	0.023	[282]
4.10E-04	3.5	50.67	1	70	2533	1	2439		63.135	[283]
1.0166				3.2			27.97			[284]