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Supporting Information

Coupling piezoelectric and piezoresistive effects in flexible pressure sensors for human motion detection from zero to high frequency

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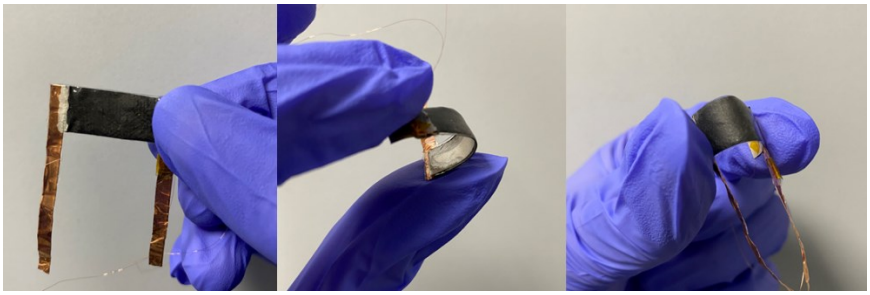

Fig. S1. Optical images of the flexible DMFS.

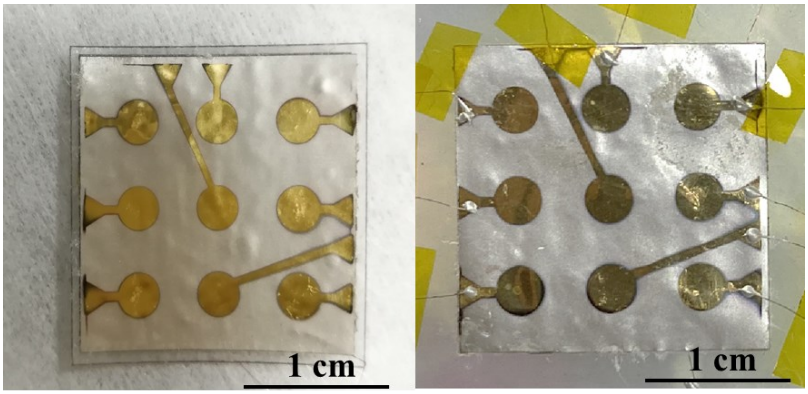

Fig. S2. The photo of DMFS array before and after leading wire.

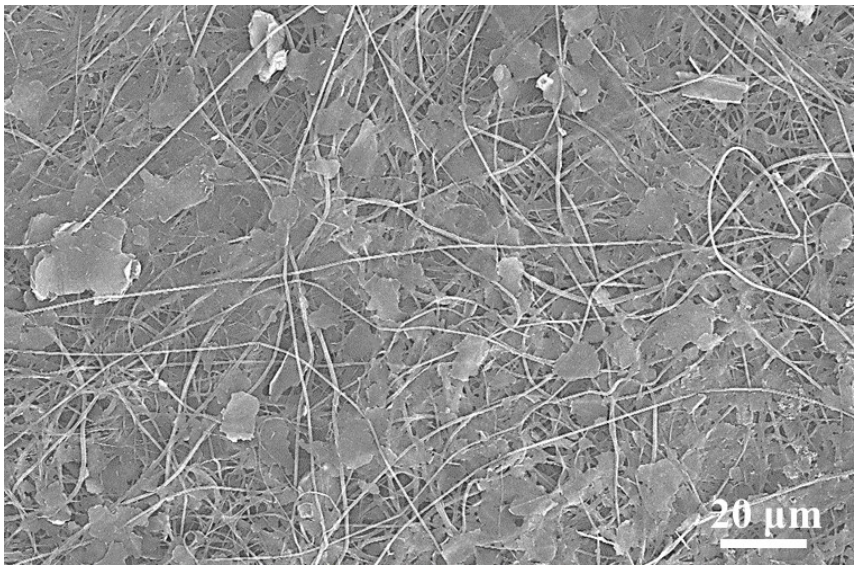

Fig. S3. SEM image of GS/PVDF at lower magnification.

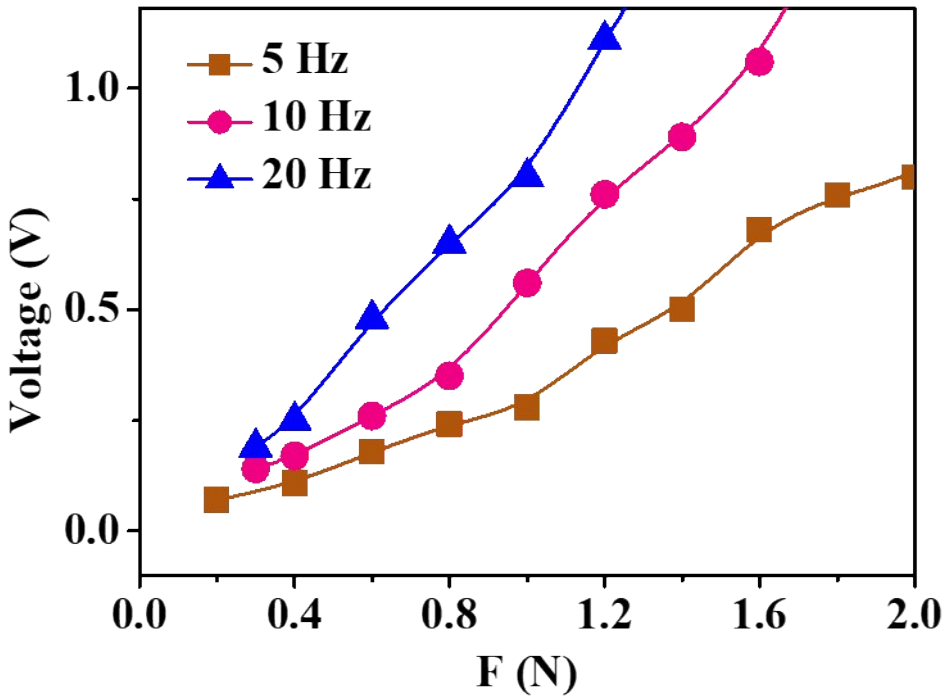

Fig. S4. The output peak voltage characteristics of DMFS at the applied frequency of 5, 10, and 20 Hz.

Table S1. Comparison of performance with recent piezoelectric and piezoresistive pressure sensor.

Mechanisms	Materials	Response time (ms)	Recovery time (ms)	Sensitivity	Ref.
Piezoelectric	ZnO	18.2	-	28.7 mV/N	[1]
Piezoelectric	PZT/PVDF	21	30	6.38 mV/N	[2]
Piezoelectric	PVDF/ZnO	16	16	0.33 V/kPa	[3]
Piezoelectric	PVDF	30	22	60.82 mV/N	[4]
Piezoelectric	PVDF	55	120	0.008 V/kPa	[5]
Piezoelectric	GaN/p-GaN	55	55	14.25 V/kPa	[6]
Piezoelectric	PZT/PDMS	-	-	8.59 mV/kPa	[7]
Piezoelectric	PZT	60	-	0.075 V/kPa	[8]
Piezoresistive	Au/PDMS	50	50	2.0 kPa^{-1}	[9]
Piezoresistive	PDMS/CNT	48	-	0.34 kPa^{-1}	[10]
Piezoresistive	MXene/Aramid nanofibers	320	98	128 kPa^{-1}	[11]
Piezoresistive	Graphene/paper	120	60	17.2 kPa^{-1}	[12]
Piezoresistive	rGO/PDMS	120	80	25.1 kPa^{-1}	[13]
Piezoresistive	MXene/PDMS	125	104	151.4 kPa^{-1}	[14]
Piezoresistive	rGO/PANI sponge	96	-	0.152 kPa^{-1}	[15]
Piezoresistive	MXene-sponge	138	127	442 kPa^{-1}	[16]
Piezoelectric	PVDF	25	25	830 mV/N	This
Piezoresistive	GS/PVDF	70	70	0.0005 kPa^{-1}	work

References

1. S. Joshi, M. M. Nayak and K. Rajanna, Small, 2018, 14, 9.
2. G. Tian, W. L. Deng, Y. Y. Gao, D. Xiong, C. Yan, X. B. He, T. Yang, L. Jin, X. Chu, H. T. Zhang, W. Yan and W. Q. Yang, Nano Energy, 2019, 59, 574-581.

3. W. L. Deng, T. Yang, L. Jin, C. Yan, H. C. Huang, X. Chu, Z. X. Wang, D. Xiong, G. Tian, Y. Y. Gao, H. T. Zhang and W. Q. Yang, Nano Energy, 2019, 55, 516-525.
4. L. Lu, B. Yang, Y. Zhai and J. Liu, Nano Energy, 2020, 76, 104966.
5. C. R. Deng, W. Tang, L. Liu, B. D. Chen, M. C. Li and Z. L. Wang, Adv. Funct. Mater., 2018, 28, 9.
6. G. Lin, Z. Fei and L. Chunfeng, Applied Mechanics and Materials, 2014, 530-531, 50-53.
7. X. J. Hou, S. N. Zhang, J. B. Yu, M. Cui, J. He, L. Li, X. D. Wang and X. J. Chou, Energy Technol., 2020, 8, 11.
8. D. Y. Park, D. J. Joe, D. H. Kim, H. Park, J. H. Han, C. K. Jeong, H. Park, J. G. Park, B. Joung and K. J. Lee, Adv. Mater., 2017, 29, 9.
9. H. Park, Y. R. Jeong, J. Yun, S. Y. Hong, S. Jin, S. J. Lee, G. Zi and J. S. Ha, Acs Nano, 2015, 9, 9974-9985.
10. C. Ma, D. Xu, Y. C. Huang, P. Q. Wang, J. Huang, J. Y. Zhou, W. F. Liu, S. T. Li, Y. Huang and X. F. Duan, Acs Nano, 2020, 14, 12866-12876.
11. L. Wang, M. Y. Zhang, B. Yang, J. J. Tan and X. Y. Ding, Acs Nano, 2020, 14, 10633-10647.
12. L. Q. Tao, K. N. Zhang, H. Tian, Y. Liu, D. Y. Wang, Y. Q. Chen, Y. Yang and T. L. Ren, Acs Nano, 2017, 11, 8790-8795.
13. Y. Pang, K. N. Zhang, Z. Yang, S. Jiang, Z. Y. Ju, Y. X. Li, X. F. Wang, D. Y. Wang, M. Q. Jian, Y. Y. Zhang, R. R. Liang, H. Tian, Y. Yang and T. L. Ren, Acs Nano, 2018, 12, 2346-2354.
14. Y. F. Cheng, Y. A. Ma, L. Y. Li, M. Zhu, Y. Yue, W. J. Liu, L. F. Wang, S. F. Jia, C. Li, T. Y. Qi, J. B. Wang and Y. H. Gao, Acs Nano, 2020, 14, 2145-2155.
15. G. Ge, Y. C. Cai, Q. C. Dong, Y. Z. Zhang, J. J. Shao, W. Huang and X. C. Dong, Nanoscale,

2018, 10, 10033-10040.

16. Y. Yue, N. S. Liu, W. J. Liu, M. A. Li, Y. A. Ma, C. Luo, S. L. Wang, J. Y. Rao, X. K. Hu, J. Su, Z. Zhang, Q. Huang and Y. H. Gao, Nano Energy, 2018, 50, 79-87.