Electronic Supplementary Material (ESI) for Energy & Environmental Science

Electronic Supplementary Information

Elastic-spring-substrated nanogenerator as active sensor for self-powered balance

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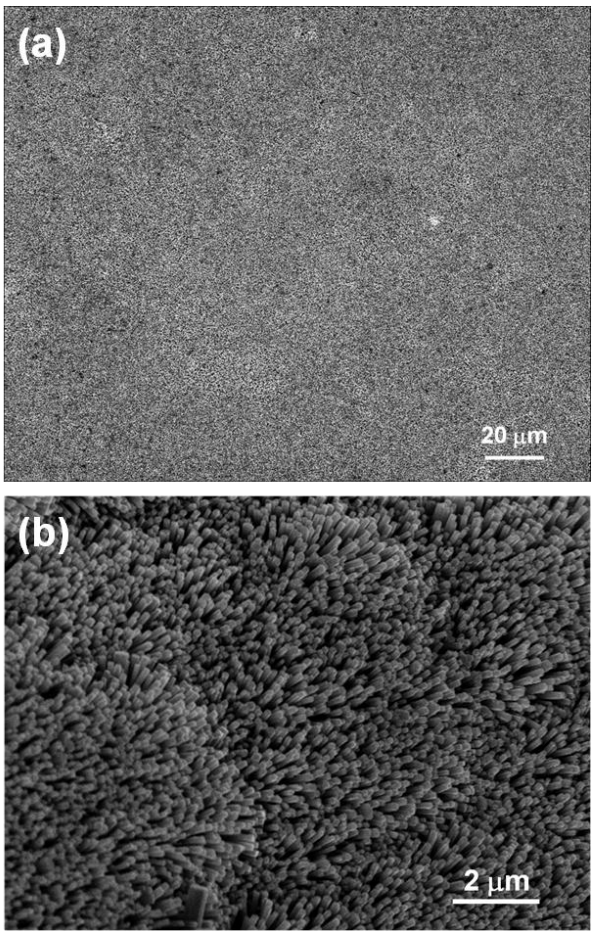

Figure S1 (a) A large scale SEM image of the ZnO nanowire film showing its uniformity on the surface of the steel spring and (b) A 45˚-tilted view SEM image showing the uniformity growth of ZnO nanowires on the surface of the steel spring.

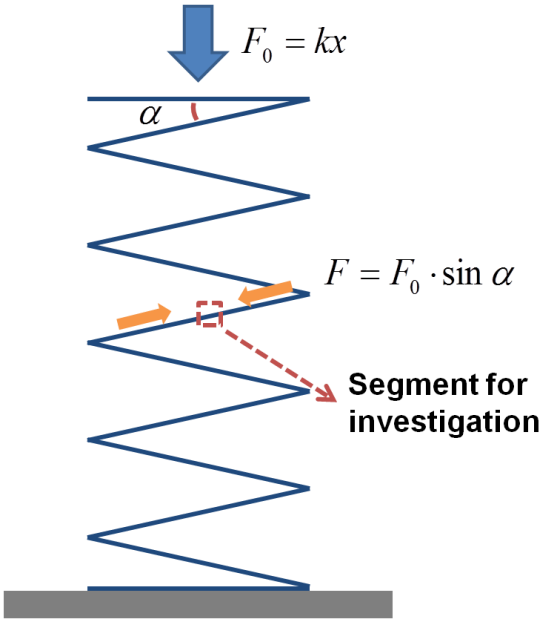

Figure S2 Schematic illustration showing the relationship between the original compressive force, the axial force on the segment of the spring, and the declination angle.

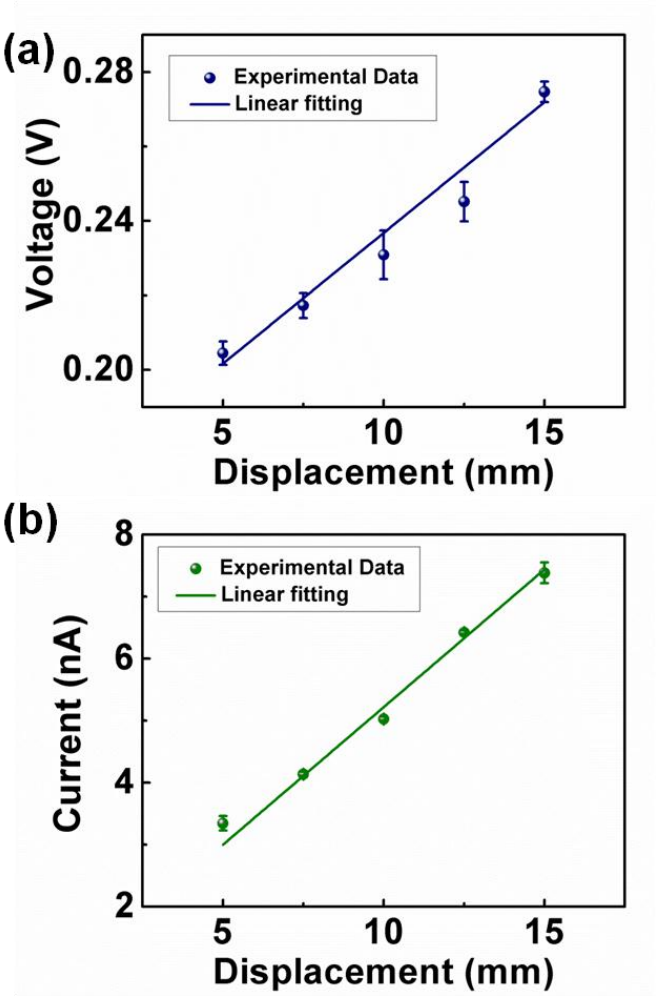

Figure S3 The linear fitting of the (a) open-circuit voltage and (b) short-circuit current with variable spring displacements ranging from 5 mm to 15 mm. The data points for the linear fitting were statistically analyzed from the magnitude of original data for the output voltage/current.

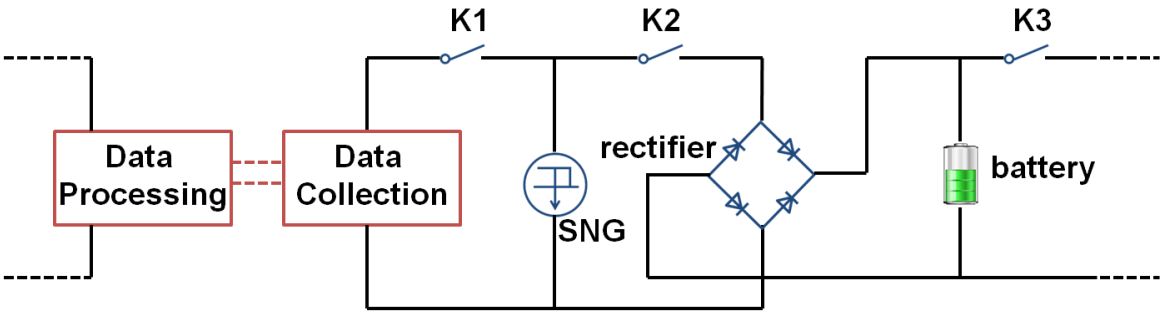

Figure S4 A proposed schematic circuitry diagram showing the self-powered operation of the active sensor based on the spring-substrated nanogenerator (SNG). In the "standby mode", the switch K2 is turned on with K1 and K3 turned off, and the SNG will be employed to generate electricity from external force and charge the battery (or other energy storage unit) through a rectifying circuit; in the "working mode", the switch K2 is turned off and the other two switches are turned on. In this mode, the data from the active sensor is acquired and analyzed by the measurement system, which could be powered up the stored energy in the "standby mode".

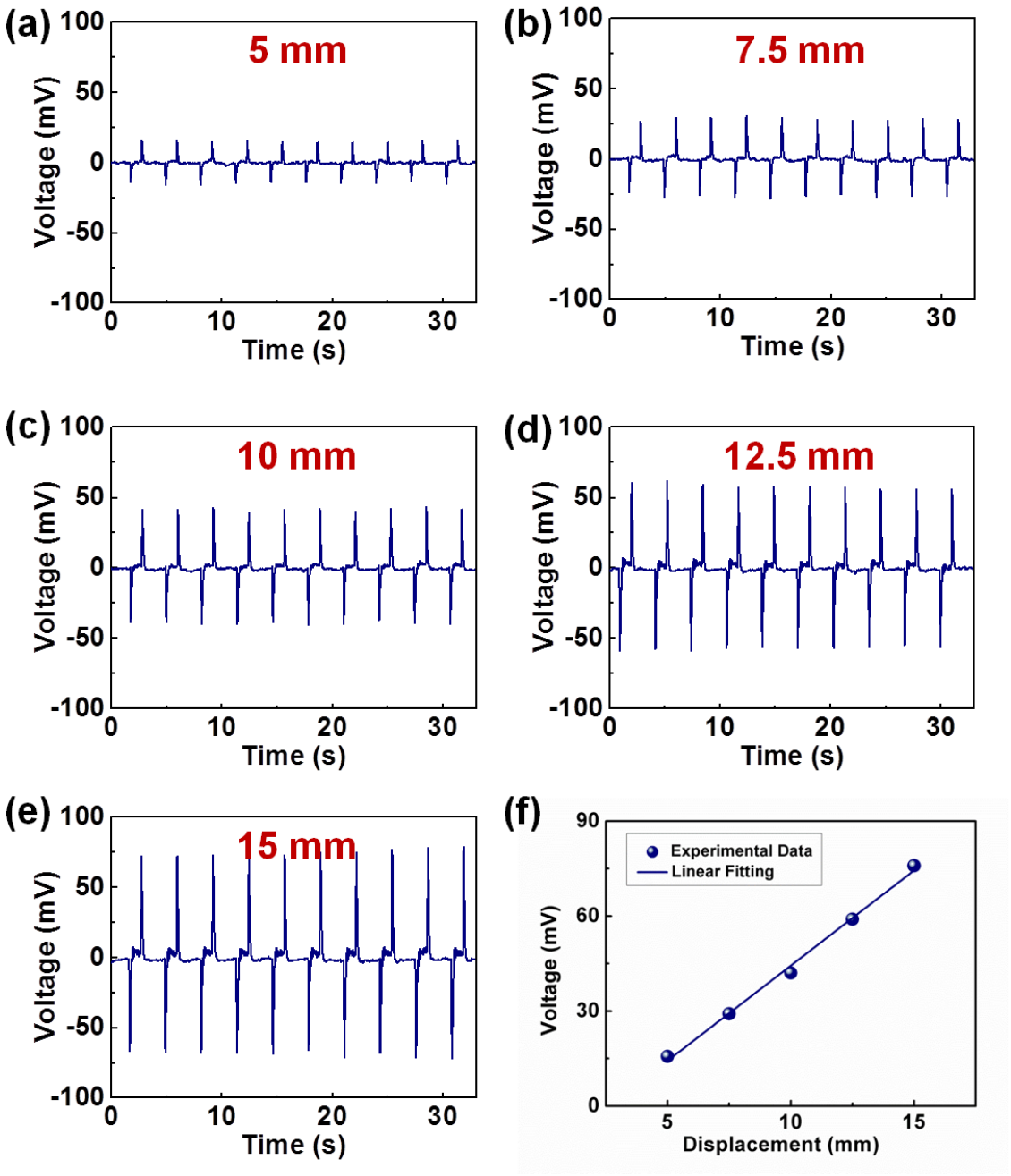

Figure S5 (a-e) The measured output voltage of the SNG with smaller sizes and with variable spring displacements ranging from 5 mm to 15 mm. (f) The linear fitting of the output voltage with variable spring displacements.

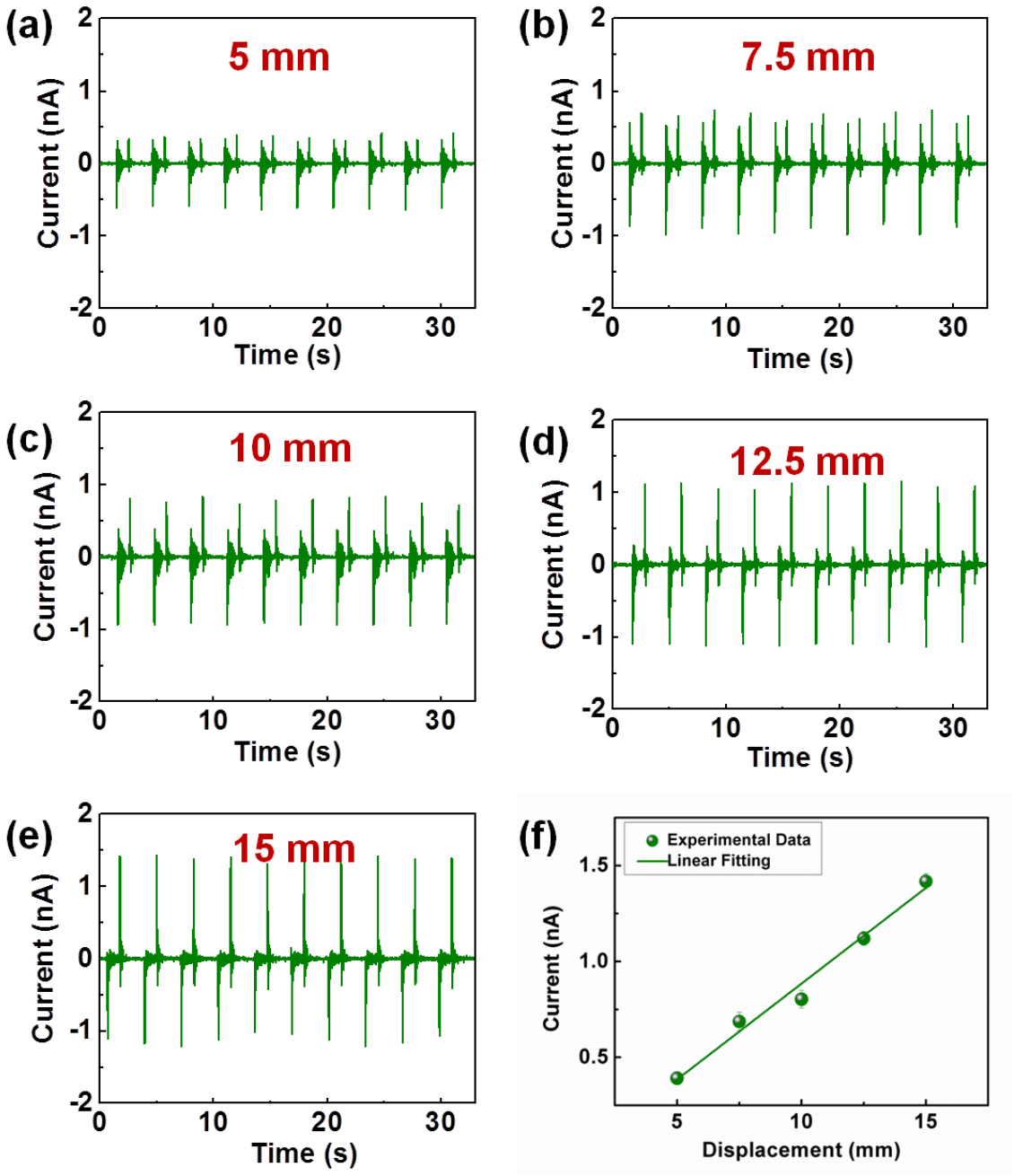

Figure S6 (a-e) The measured output current of the SNG with smaller sizes and with variable spring displacements ranging from 5 mm to 15 mm. (f) The linear fitting of the output current with variable spring displacements.

Table S1 Specification of the springs involved in the fabrication

Model	**1NBW2**	**1NBV9**
Composition	High carbon steel	High carbon steel
Free Length (inch)	2.5	2
Outer Diameter (inch)	0.438	0.312
Wire Diameter (inch)	0.048	0.029
Number of Coils	14	10
Spring Constant (lbs/inch)	8.66	2.76
Wire Type	Round	Round
End Type	End	End