Supporting Information

Experimental Section

Material. Silicone elastomer (Ecoflex 00-30) was purchased from Smooth-On Inc. Transition metal-doped ZnS phosphors were received from Global Tungsten & Powders Corp.

Synthesis of spinnable carbon nanotube array. The spinnable CNT arrays were synthesized by chemical vapor deposition with Fe (1.2 nm)/Al_2O_3 (3 nm) deposited on silicone wafer as the catalyst at 740 °C. Ethylene and a gas mixture of Ar and H_2 were used as carbon source and carrier gas with the flow rates of C_2H_4, H_2 and Ar being nearly 90, 30 and 400 cm^3/min, respectively.

Preparation of inner electrode. Firstly, the elastic polymer fiber was prepared by injecting the silicone elastomer solution into a heat-shrinkable tube, followed by curing at 80 °C for 1 h and then drawing out of the heat-shrinkable tube. Subsequently, the aligned CNT sheet was continuously wrapped around the pre-stretched elastic polymer fiber (100% strain). The spinnable CNT array and pre-stretched elastic polymer fiber were first fixed by a precisely motorized translation stage and two motors, respectively. An aligned CNT sheet that was drawn out of the spinnable CNT array was then continuously wrapped around the pre-stretched elastic polymer fiber with a fixed angle of α. Finally, this inner electrode was released to the relaxing state. Here the thickness of the wrapped CNT sheet on the elastic polymer fiber can be accurately controlled by varying the width of the CNT sheet, helical angle α and wrapping time with the detailed calculation provided below.

Calculation of the thickness of CNT sheet wrapped on the elastic polymer fiber. During the wrapping process of CNT sheet, the angle between the elastic polymer fiber and CNT sheet was kept at 45° in order to synchronize the precession velocity of the CNT sheet and moving velocity (v) of the translation stage. During the wrapping time (t), the area of the used CNT sheet (S_1) was calculated by $S_1=v\times t\times a/cos45^o$, and the CNT-wrapped surface area of the elastic polymer fiber (S_2) was calculated by $S_2=2\pi r\times v\times t$. Here r and a correspond to the radius of the elastic polymer fiber and

width of the used CNT sheet (7 mm), respectively. The average numbers of wrapped CNT sheet layers (n) were calculated by $n=S_1/S_2$. Therefore, the average numbers of wrapped CNT sheet layers were 2.7 with the corresponding thickness approaching to 48.6 nm (Table 1).

Characterization. The structures were characterized by scanning electron microscope (Hitachi FE-SEM S-4800 operated at 1 kV). The electrical properties were tested with a Keithley 2400 source meter. Transmittance spectra were characterized by a Shimadzu UV-2550 spectrophotometer. The emission intensity was measured with a Photoresearch PR-680 under a sinusoidal waveform using the high-voltage amplifier (610 D; TREK Inc.) and function generator (3312 A; Hewlett Packard). The measuring accuracy of the PR-680 in luminance was below nearly 0.1 cd/m^2, so the brightness tendency in Fig. 4a was reliable. The stretching and pressing process was conducted by an HY0350 Table-top Universal Testing Instrument.

Table S1 Parameters for wrapping aligned CNT sheets onto the elastic polymer fiber with increasing helical angles.

Helical angle (°)	30	45	60
Average layer number	2.2	2.7	3.8
Average thickness (nm)	39.6	48.6	68.4

Table S2 Comparison on the luminance and stretchability between our electroluminescent fiber and those of other reports on stretchable electroluminescent devices.

Electroluminescent devices	Maximum luminance (cd/m^2)	Maximum strain (%)	Stretching number	Luminance after stretching (%)
This work	14.48	200	200	97.5
ZnS[S1]	-	500	-	-
ZnS[S2]	95	700	1000 (400%)	85
ZnS[S3]	121	100	500 (50%)	nearly 100
ZnS[S4]	25	400 (area strain)	-	-
ZnS[S5]	220	100	1000 (80%)	65
ZnS[S6]	9.4	1500 (area strain)	-	-
PF-B/PEO-DMA /LiTf[S7]	170	45	-	-
Super Yellow/PEO /LiTf[S8]	2200	120	1000 (10%)	35
AnE-PVstat[S9]	113	100	-	-
$MAPbBr_3$/PEO[S10]	15960	40	100	20

PF-B: a blue emissive polyfluorene copolymer

PEO-DMA: poly(ethylene oxide) dimethacrylate ether

LiTf: lithium trifluoromethane sulfonate

Super Yellow: phenyl substituted poly(1,4-phenylene vinylene)

PEO: poly(ethylene oxide)

AnE-PVstat: anthracene-containing poly(p-phenylene-ethynylene) -altpoly(p-phenylene-vinylene) (PPE-PPV) derivative with a statistical distribution of linear octyloxy and branched 2-ethylhexyloxy side groups

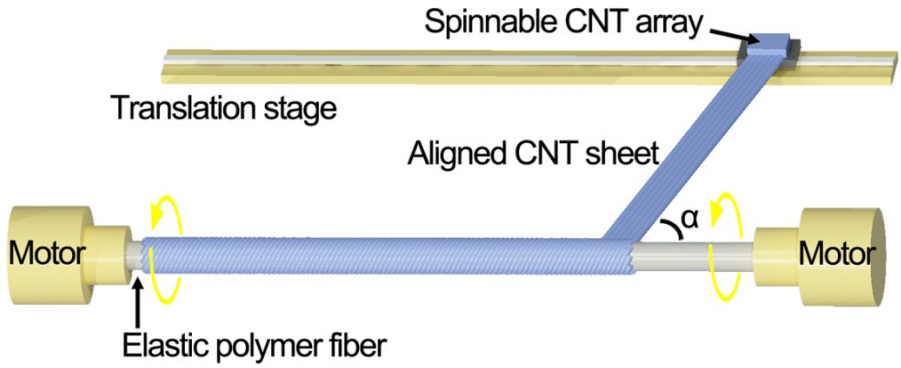

Fig. S1 Schematic illustration to the preparation of the inner electrode.

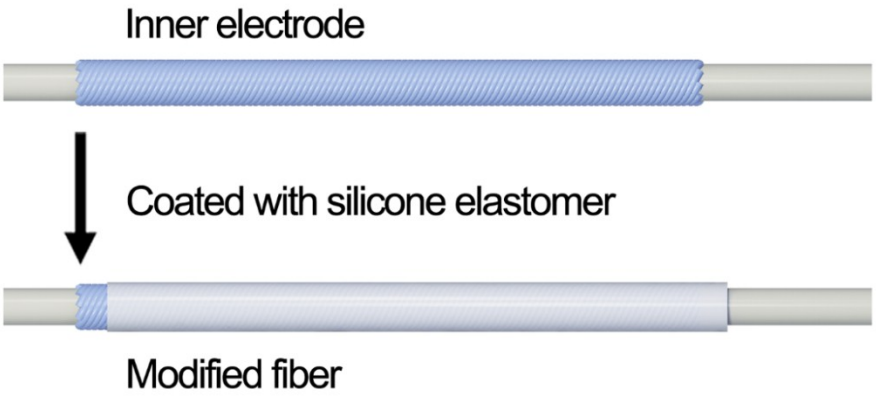

Fig. S2 Schematic illustration to the structure of the inner electrode after coat with a silicone elastomer layer.

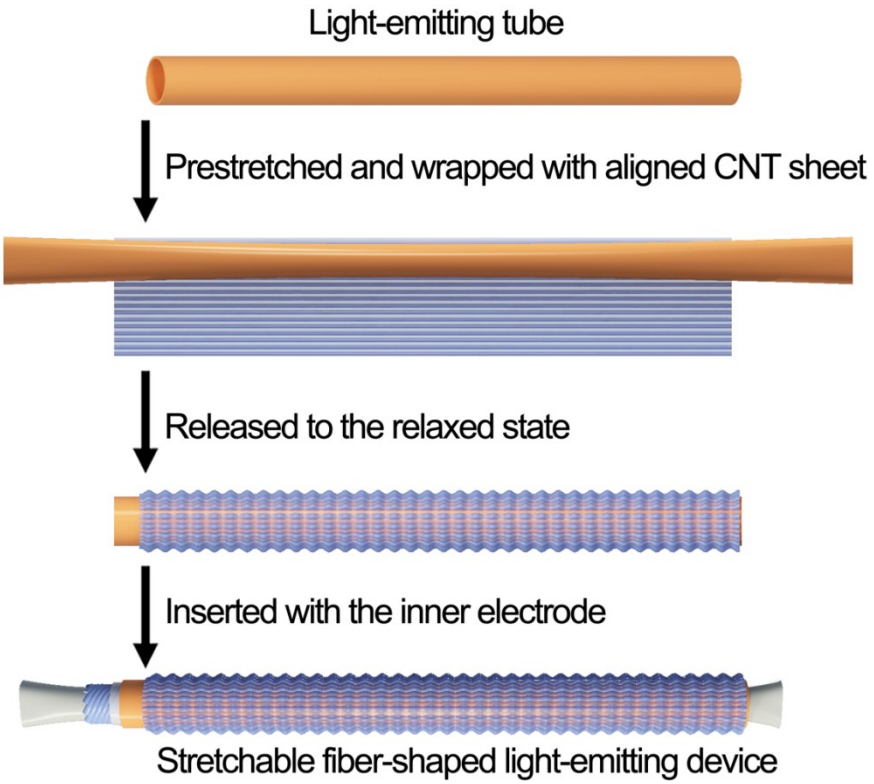

Fig. S3 Schematic illustration to the fabrication of the SCLED.

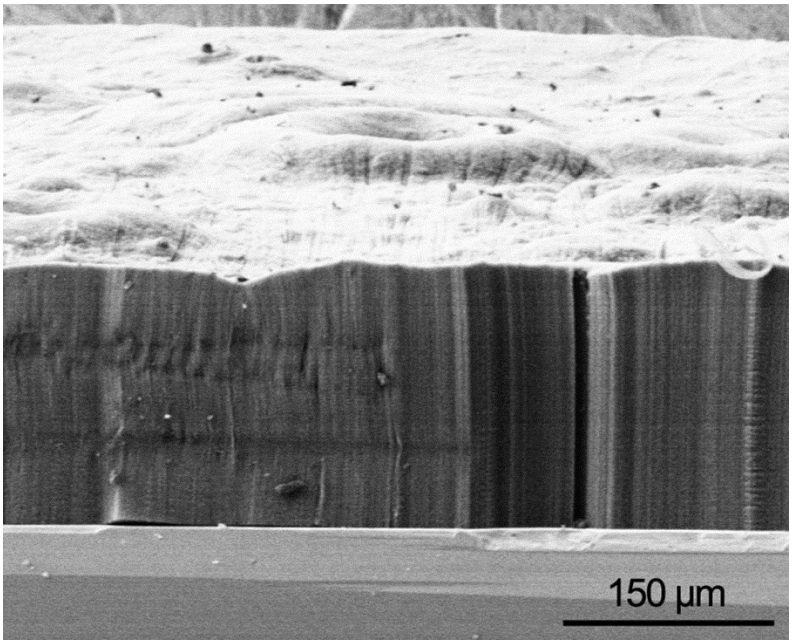

Fig. S4 SEM image of a spinnable CNT array.

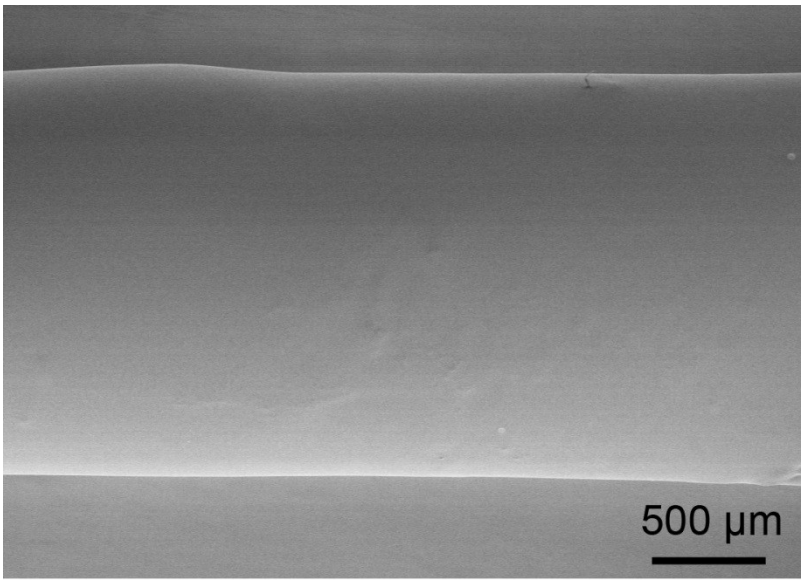

Fig. S5 The inner electrode after coat with a silicone elastomer layer.

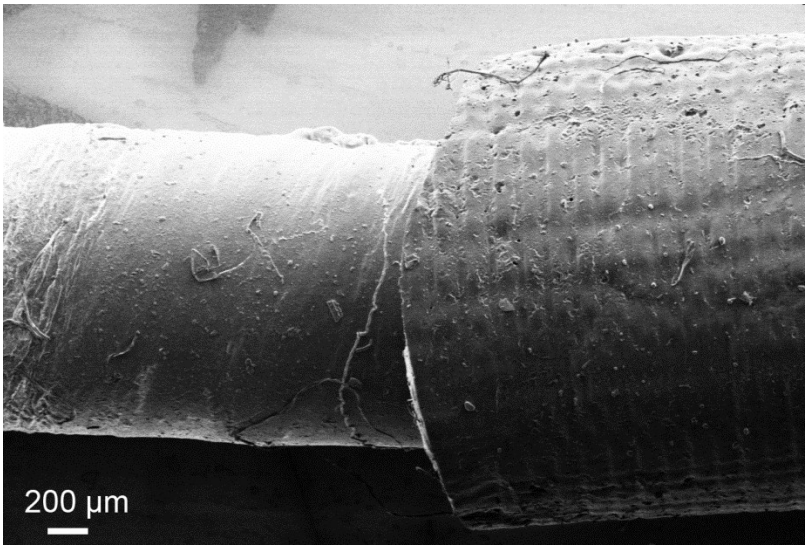

Fig. S6 The modified inner electrode after inserting into a light-emitting tube.

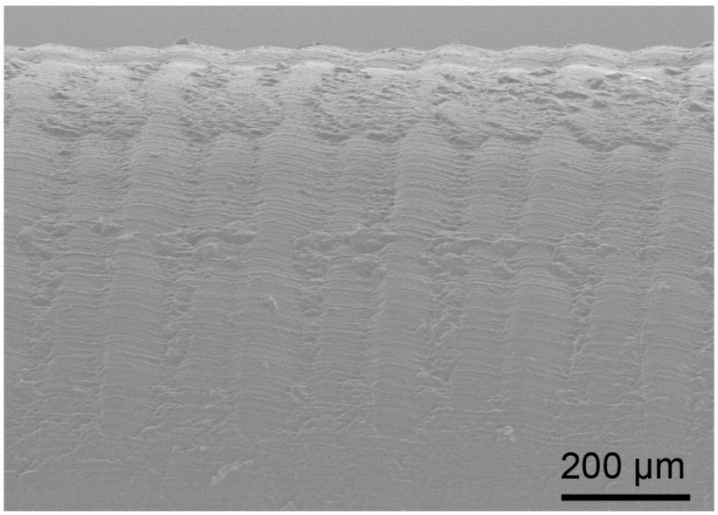

Fig. S7 SEM image of the outer CNT sheet electrode at a low magnification.

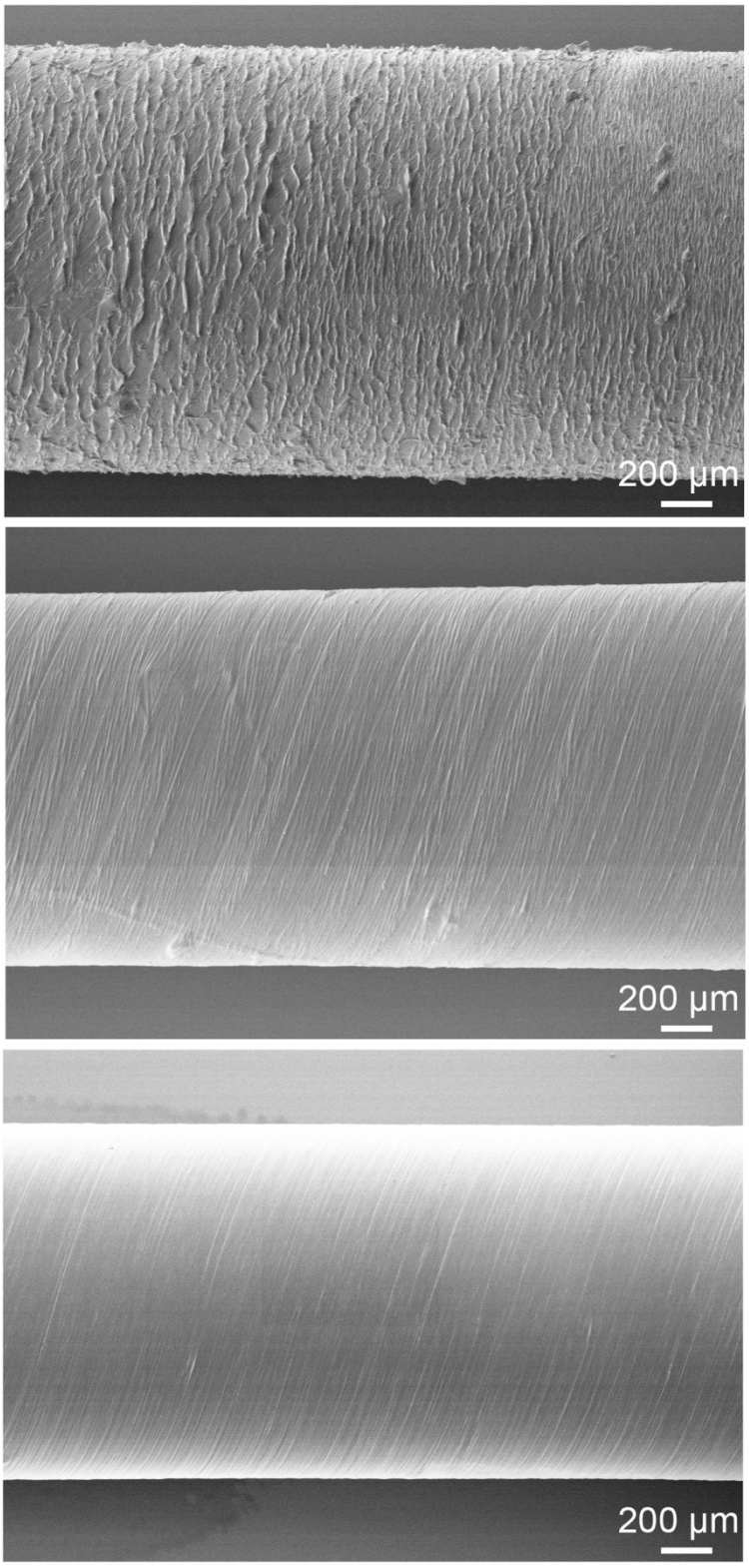

Fig. S8 SEM images of inner electrodes with increasing wrapping helical angles from 30^{o} (top image) and 45^{o} (middle image) to 60^{o} (bottom image) at a pre-stretched strain of 100%.

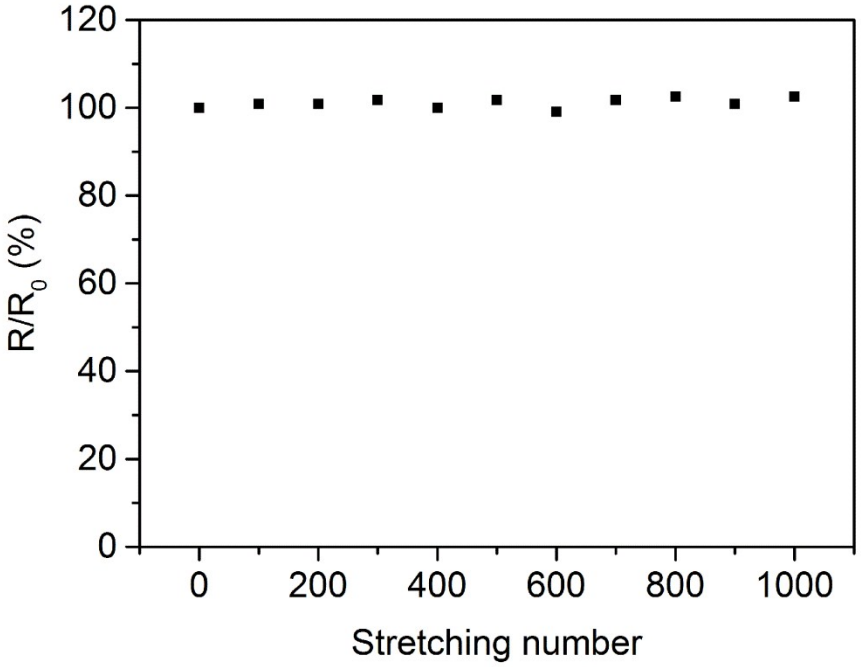

Fig. S9 Dependence of electrical resistance of the inner electrode on stretching number at a strain of 200%. R_0 and R correspond to the electrical resistances before and after stretching, respectively.

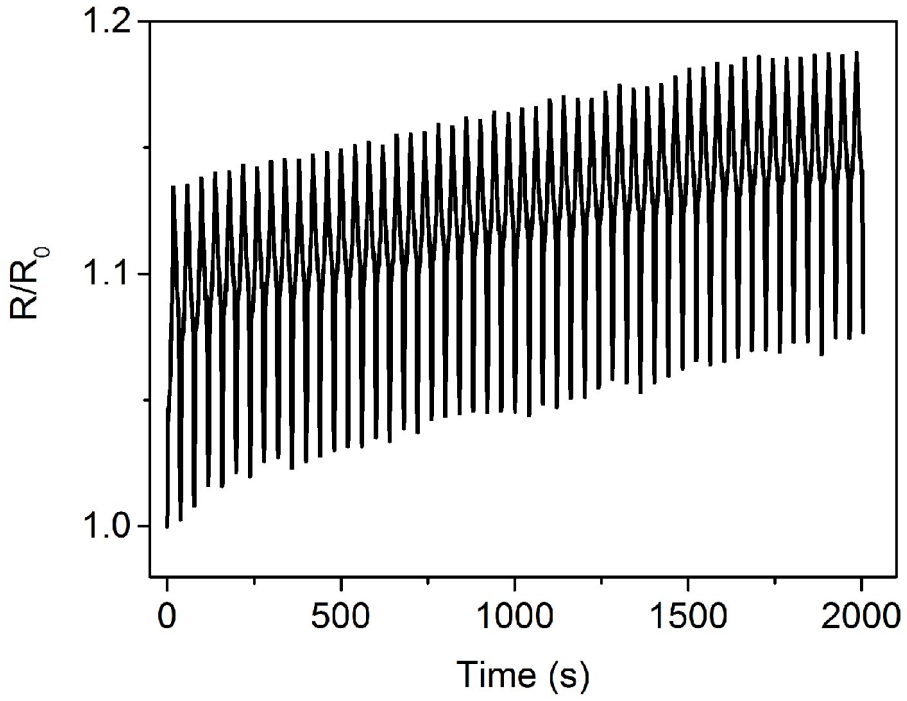

Fig. S10 Dependence of electrical resistance of the outer electrode on time under the repeated stretching and releasing process.

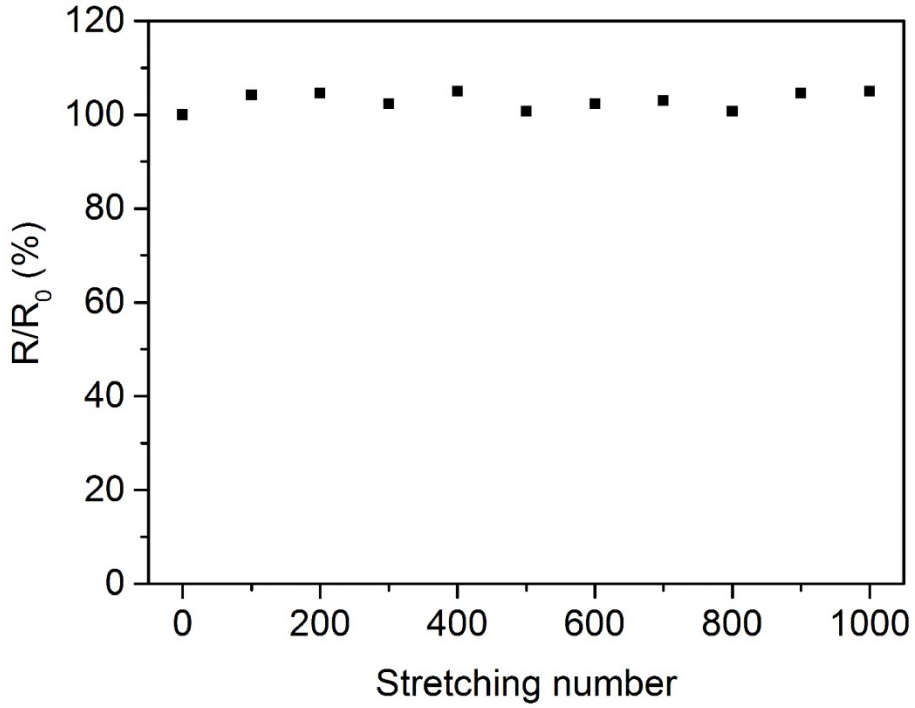

Fig. S11 Dependence of electrical resistance of the outer electrode on stretching number at a strain of 200%. R_0 and R correspond to the electrical resistances before and after stretching, respectively.

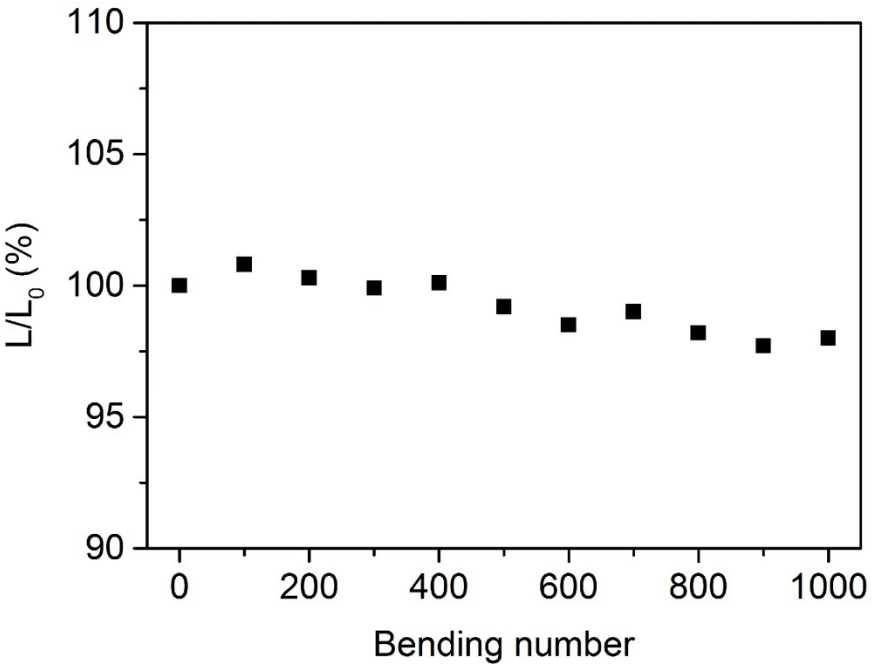

Fig. S12 Dependence of the emission intensity of the SCLED on bending number.

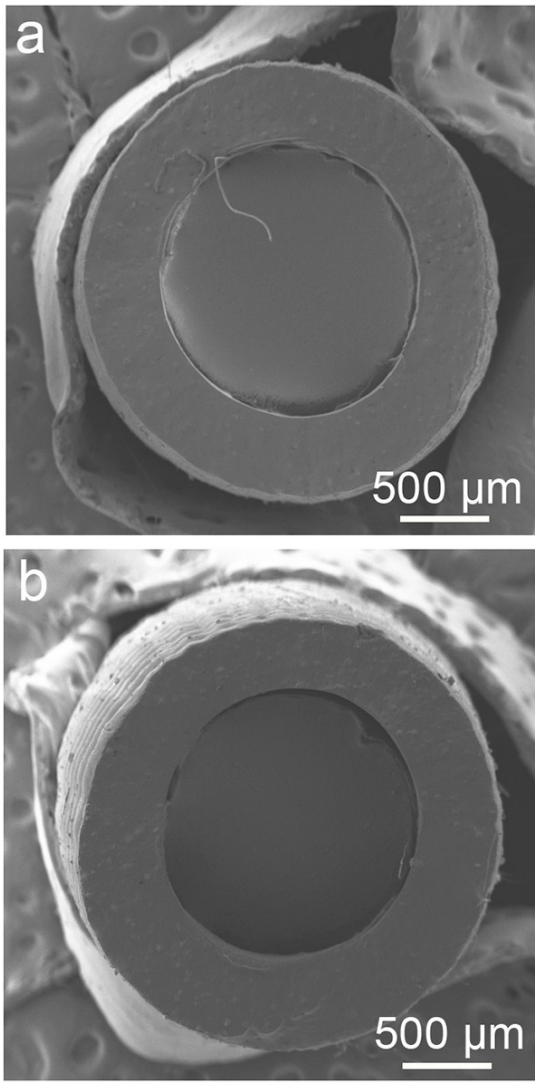

Fig. S13 Cross-sectional SEM images of the SCLEDs after (a) stretching for 200 cycles at a strain of 200% and (b) bending for 1,000 cycles.

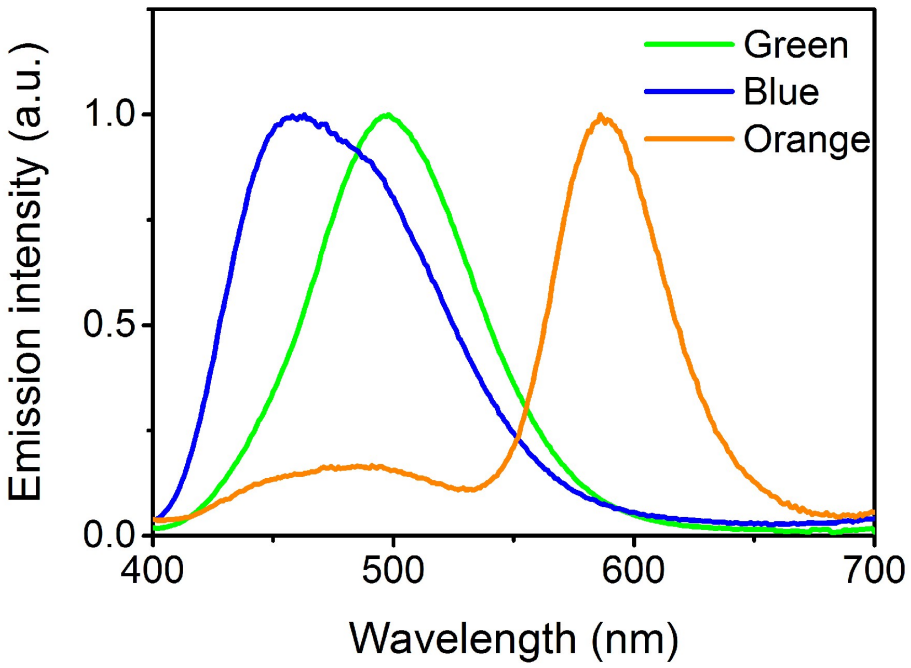

Fig. S14 Photoluminescence spectra of the different colors of ZnS powders.

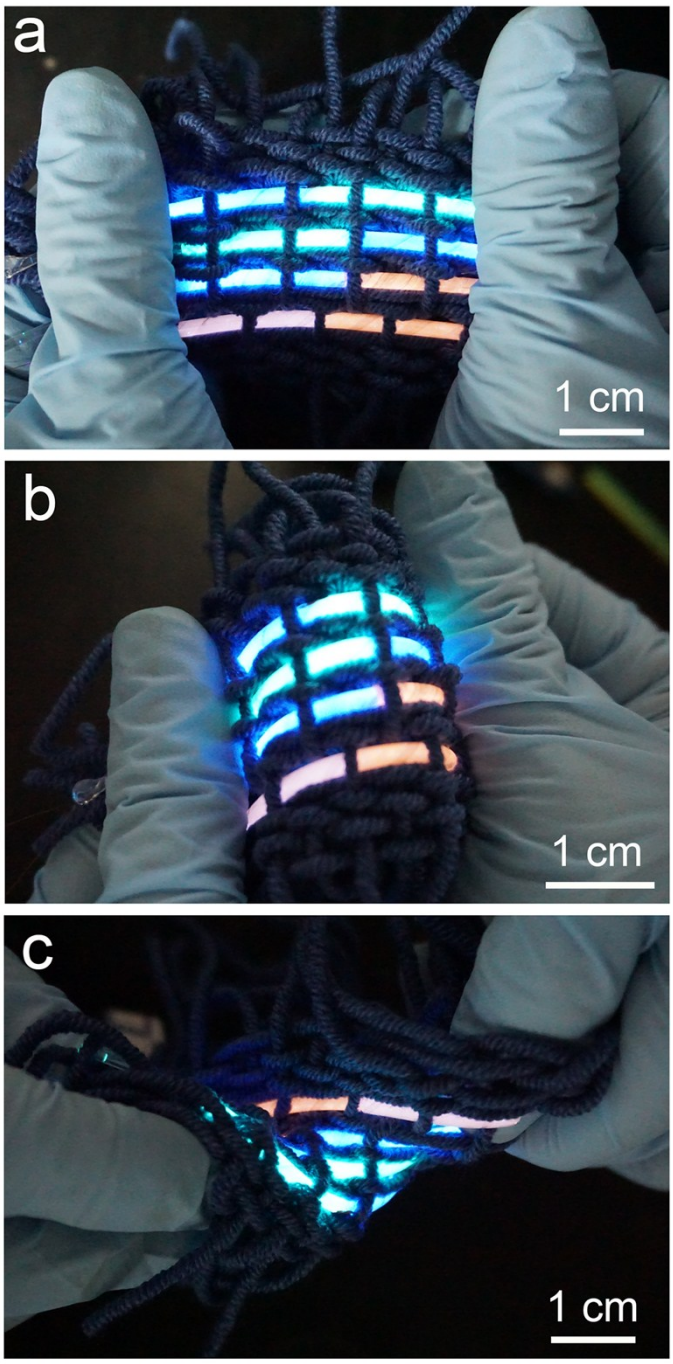

Fig. S15 Photographs of the SCLEDs being woven into fabric at (a) original, (b) bending and (c) twisting states.

References for Supporting Information

S1 C. Larson, B. Peele, S. Li, S. Robinson, M. Totaro, L. Beccai, B. Mazzolai and R. Shepherd, *Science* 2016, **351**, 1071.

S2 J. X. Wang, C. Y. Yan, G. F. Cai, M. Q. Cui, A. L. S. Eh and P. S. Lee, *Adv. Mater.* 2016, **28**, 4490.

S3 F. Stauffer and K. Tybrandt, *Adv. Mater.* 2016, **28**, 7200.

S4 S. Li, B. N. Peele, C. M. Larson, H. C. Zhao and R. F. Shepherd, *Adv. Mater.* 2016, **28**, 9770.

S5 J. X. Wang, C. Y. Yan, K. J. Chee and P. S. Lee, *Adv. Mater.* 2015, **27**, 2876.

S6 C. H. Yang, B. H. Chen, J. X. Zhou, Y. M. Chen and Z. G. Suo, *Adv. Mater.* 2016, **28**, 4480.

S7 Z. Yu, X. Niu, Z. Liu and Q. Pei, *Adv. Mater.* 2011, **23**, 3989.

S8 J. J. Liang, L. Li, X. F. Niu, Z. B. Yu and Q. B. Pei, *Nature Photon.* 2013, **7**, 817.

S9 M. S. White, M. Kaltenbrunner, E. D. Glowacki, K. Gutnichenko, G. Kettlgruber, I. Graz, S. Aazou, C. Ulbricht, D. A. M. Egbe, M. C. Miron, Z. Major, M. C. Scharber, T. Sekitani, T. Someya, S. Bauer and N. S. Sariciftci, *Nature Photon.* 2013, **7**, 811.

S10 S. G. R. Bade, X. Shan, H. Phong Tran, J. Li, T. Geske, L. Cai, Q. Pei, C. Wang and Z. Yu, *Adv. Mater.* 2017, DOI: 10.1002/adma.201607053.