Supplementary Information

Highly Twisted Supercoils for Superelastic Multi-Functional Fibers

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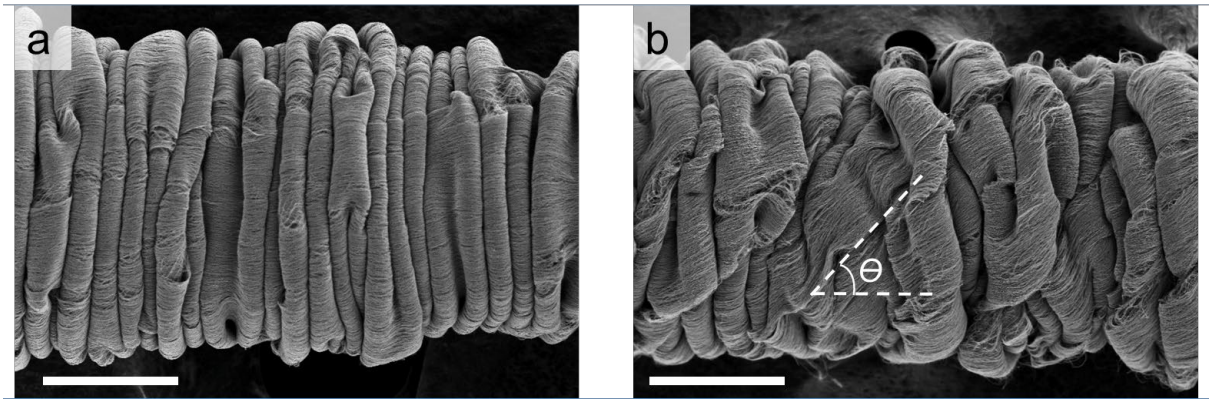
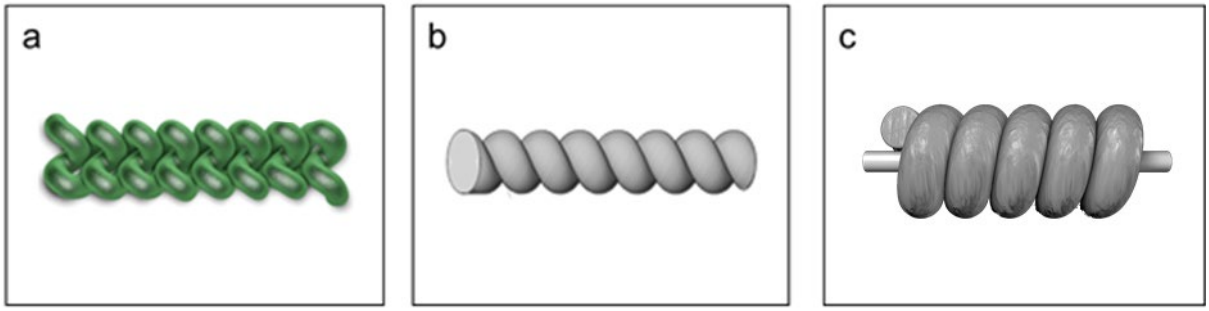
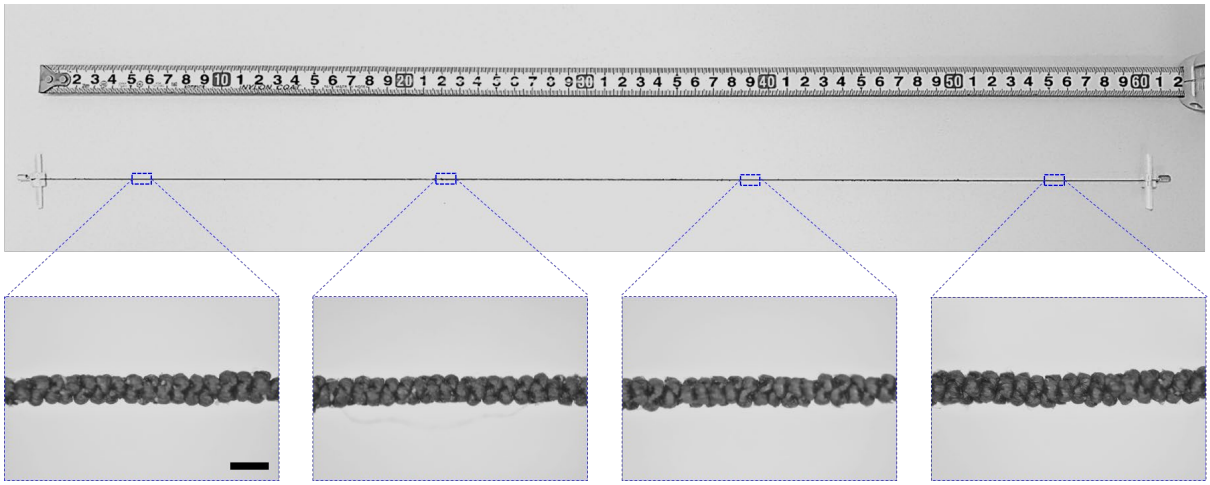
Supplementary Figure 1. Photographs of CNT sheets wrapping process on the stretched (ε_{fab} = 400%) spandex core fibre



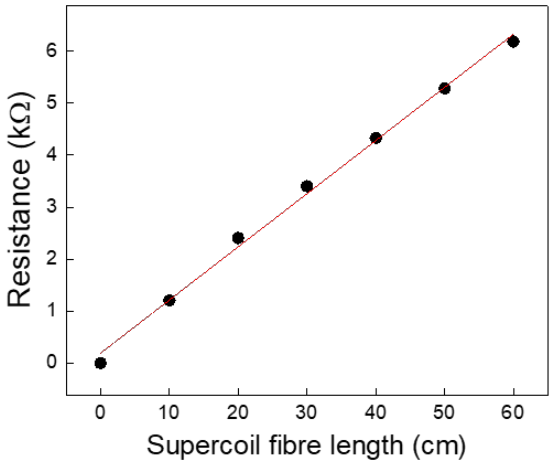
Supplementary Figure 2. SEM images of the spandex@CNT fibre (a) before, and (b) after twist insertion just before first-coil formation (scale bars = 100 μm).



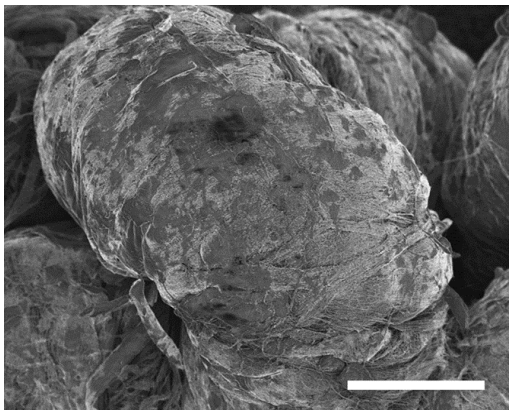
Supplementary Figure 3. Schematic illustrations of (a) supercoiled, (b) coiled, and (c) helical coiled fibres



Supplementary Figure 4. Photograph (upper) and magnified optical images (lower) of four different spots on a 60 cm-long supercoil fibre (scale bar = 500 μm).



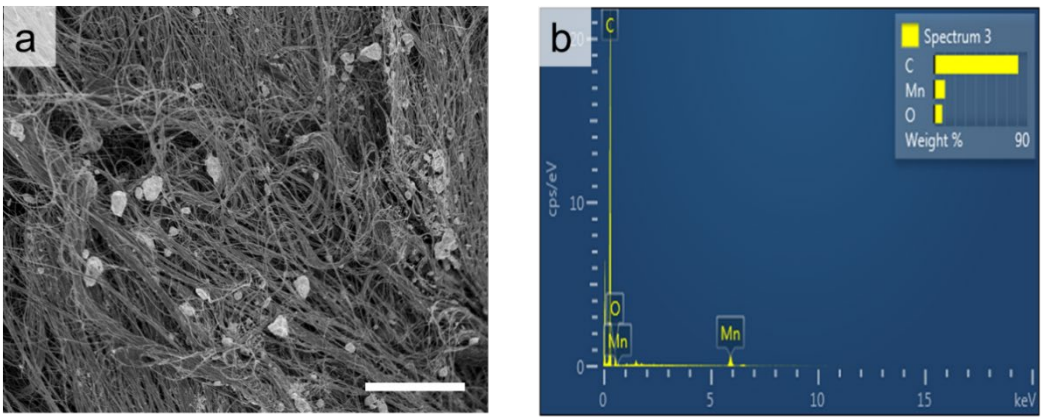
Supplementary Figure 5. Measured electrical resistance versus length of a 60 cm-long supercoil fibre.



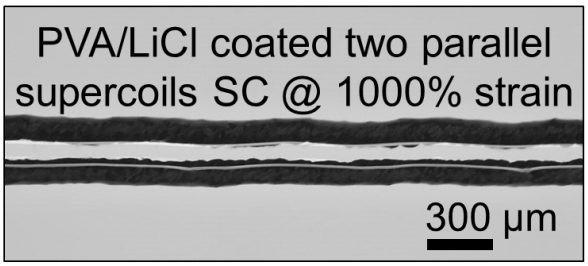
Supplementary Figure 6. SEM image of a SEBS-overcoated spandex@CNT supercoiled fibre (scale bars = 100 μm)

Supplementary Table 1. Quality factor (Q) comparison of presented supercoiled fibres with prior-art elastic yarn or fibre conductors

Structures and materials (Ref. No.)	Stretchability [$\Delta L/L_0$, %]	Resistance change [$\Delta R/R_0$, %]	Quality factor [$\Delta L \cdot R_0/\Delta R \cdot L_0$]
Spandex@ SEBS/CNT supercoiled fibres (present work)	1,000	4.19	238.8
(a) Buckled CNT@sandwich structured rubber fibre (1)	200	3.7	54
(b) Buckled CNT@SEBS fibre (2)	800		65.1
(c) CNT@nylon coiled fibre (3)	150	1373.7	0.109
(d) Buckled CNT@coiled rubber fibre (4)	400	221.7	1.8
(e) CNT@elastomer polymer fibre (5)	700	450	1.55



Supplementary Figure 7. (a) SEM image (scale bar = 10 μm), and (b) EDX elemental analysis of a MnO_2 coated spandex@CNT supercoiled fibre.



Supplementary Figure 8. Optical image of a supercoil based solid-state supercapacitor at 1000% tensile strain application, which comprises of two parallel, symmetric spandex@MnO_2/CNT supercoil fires and PVA/LiCl gel electrolyte coating (scale bar = 300µm).

Supplementary Table 2. Comparison of specific capacitance for the supercoil supercapacitor with prior-art yarn or fibre based elastic supercapacitors

Electrode Materials (Ref. No.)	C_L [mF cm^{-1}]	C_A [mF cm^{-2}]	**Stretchability [%]**
Spandex@MnO_2/CNT supercoiled fibres (this work)	21.7	92.1	1,000
MnO_2/CNT@coiled nylon fibres (3)	5.4	40.9	150
Buckled MnO_2/CNT@coiled rubber fibres (4)	4.8	22.8	400
Buckled MnO_2/CNT@sandwich structured rubber fibres (1)	2.4	11.9	200
PANI/CNT@elastomeric polymer fibres (5)	0.9	50.1	400
MnO_2/CNT@spandex, CNT@spandex asymmetric fibres (6)	0.26	27.9	100
CNT/graphene/PANI helical-coil fibres (7)	10.3	273.7	800
PEDOT-S:PSS helical-coil fibre (8)		93.1	400
SEBS@CNT/graphene/MnO_2 helical-coil fibres (9)		14	850

Supplementary References

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