Electronic Supplementary Material (ESI) for Nanoscale.
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-Supporting Information-

Solution Synthesis of Helical Gold Nanowire Bundles

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Experimental Section

Materials

All solutions were prepared using deionized water (resistivity > 18 M·cm^{-1}). 4-mercaptobenzoic acid (4-MBA, 90%, Sigma-aldrich), 2-naphthalenethiol (99%, Sigma-aldrich), 3-mercaptobenzoicacid (95%, Sigma-aldrich), 4-mercaptophenylboronicacid (90%, Sigma-aldrich), 4-mercaptophenylaceticacid (97%, Sigma-aldrich), Hydrogen tetrachloroaurate(III) hydrate($HAuCl_4.3H_2O$, 99.9%, metal basis Au 49%, Alfa-Aesar), L-ascorbic acid (99%, Sigma-aldrich) and ethanol (AR), acetone (AR),N,N-dimethylformamide(99.8%), isopropanol (AR) were used as received.

Characterization

Copper specimen grids (200 mesh) with formvar/carbon support film were purchased from Beijing Zhongjingkeyi Technology Co. Optical microscope images were collected on ECLIPSE Ti2 - Nikon camera. Field emission scanning electron microscopy (SEM) images were collected on a FEI Quanta 250 FEG model.

Transmission electron microscopy (TEM) images were collected from a Talos L120C model operated at 120 kV.

Preparation of SEM Samples

Black flocculent sediments were collected by centrifugation, washed with ethanol, and dried on silicon wafers in air.

Synthesis of helical gold bundles

In a 5 mL test tube, 0.5 mL of 4-MBA solution(3.3 mM in ethanol) was mixed with 0.5 mL of $HAuCl_4$ solution(5.1 mM in H_2O:ethanol=1:1) to give a pale yellow solution. 0.5 mL of L-ascorbic acid (12.3 mM in H_2O) was added as reducing agent under shaking, giving a white flocculent suspension. The reaction mixture was incubated stationary at room temperature for 4 days. The colour of the floccule gradually changed from white into black. The sediments were collected by centrifugation, washed with ethanol and dried in air.

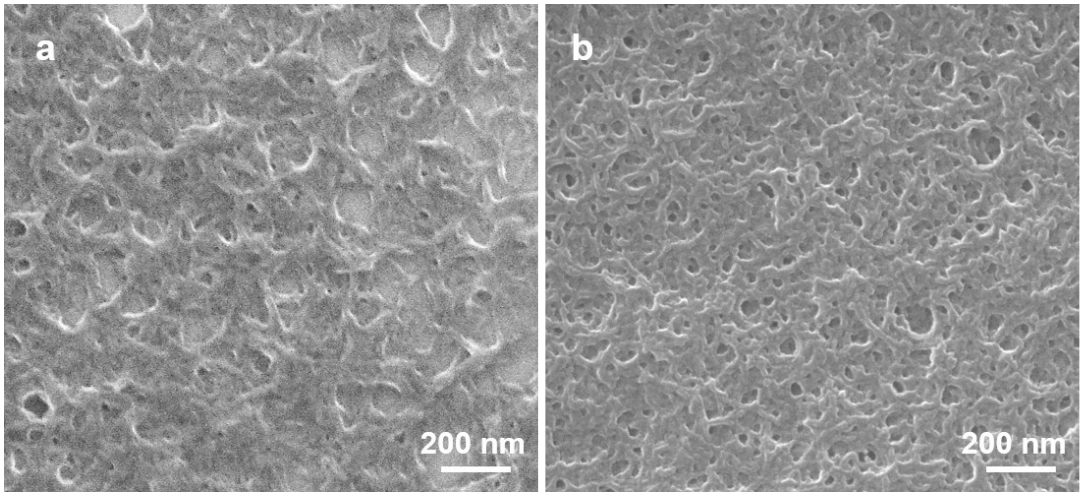

Figure S1. SEM images of the white floccule intermediates, a) not spray gold, b) After spray gold.

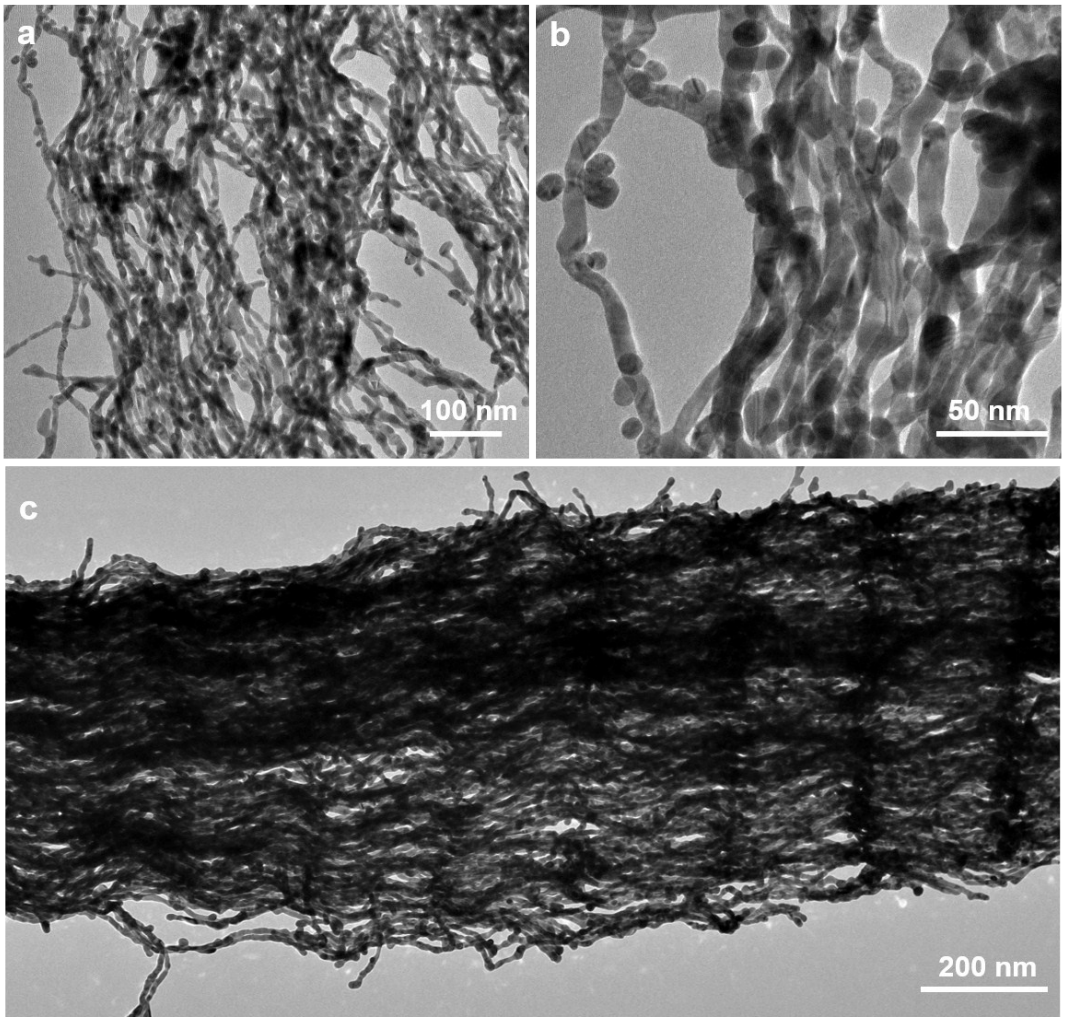

Figure S2. TEM images of the helical nanowire bundles, a-b) magnified images showing the helical bundle and the nanowires; c) typical Au helical nanowire bundles.

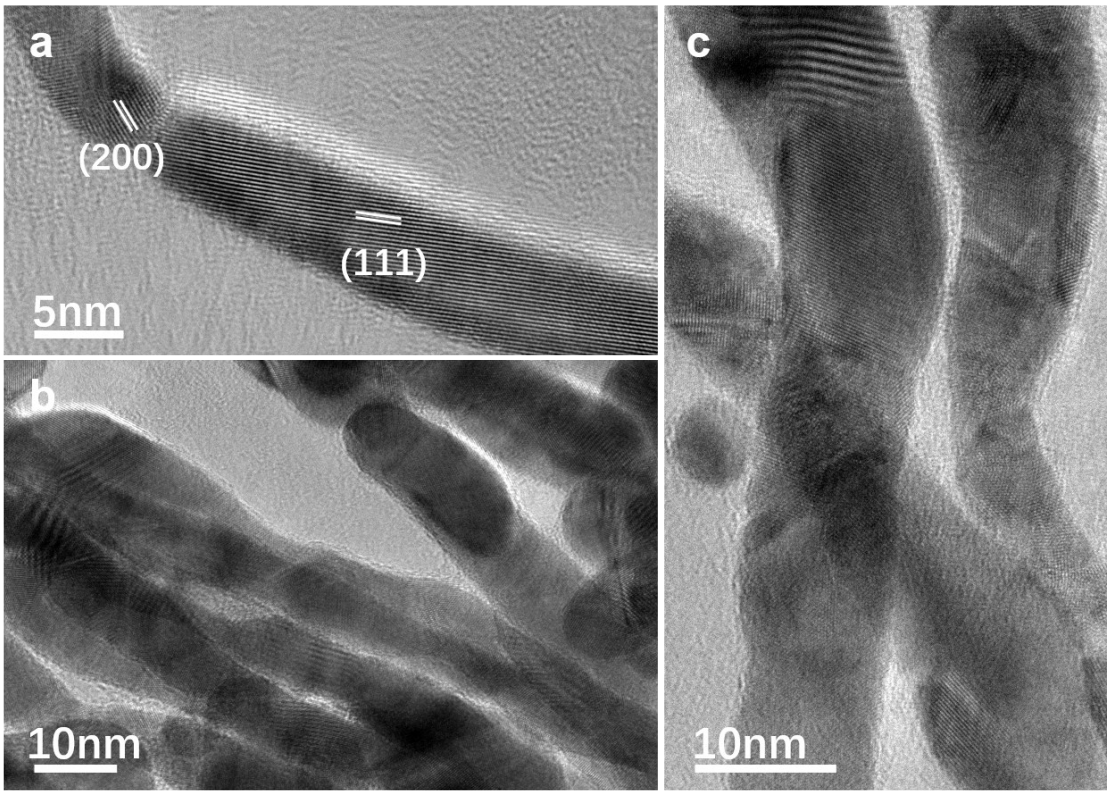

Figure S3. High resolution TEM of the helical nanowire bundles.

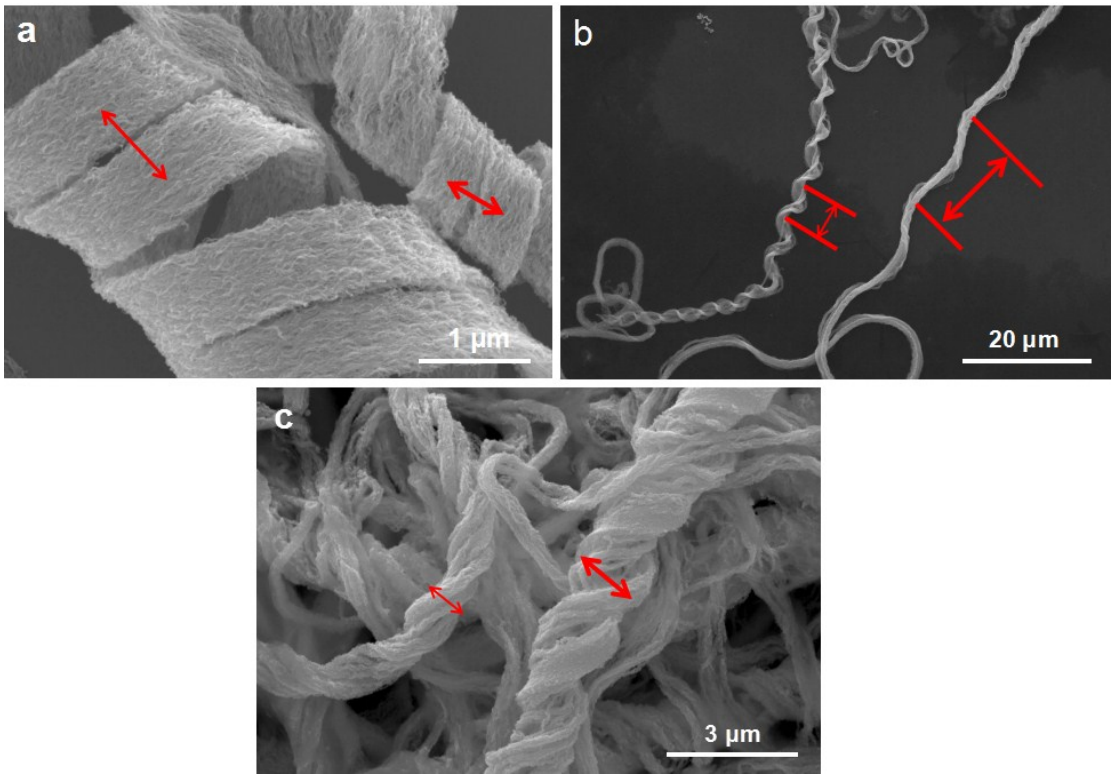

Figure S4. SEM images of the helical nanowire bundles with various pitches and helical radius: (a) A helical bundle with pitch length of 0.8 μm and 1 μm; (b) Two

helical bundles in one sample with pitch length of 15 μm and 5 μm; (c) Helical bundles with different helical radii.

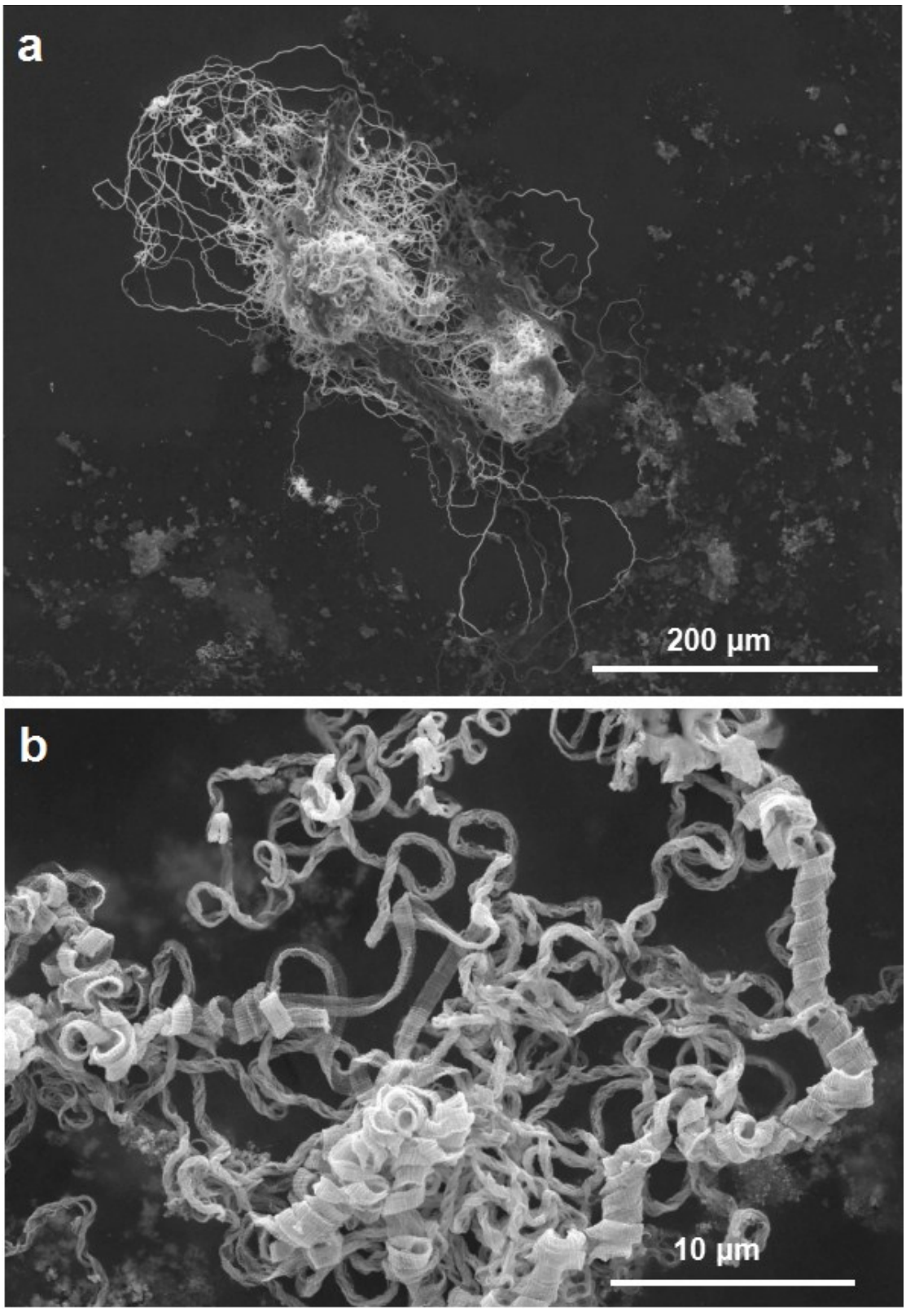

Figure S5. Large-area SEM images of the helical nanowire bundles.

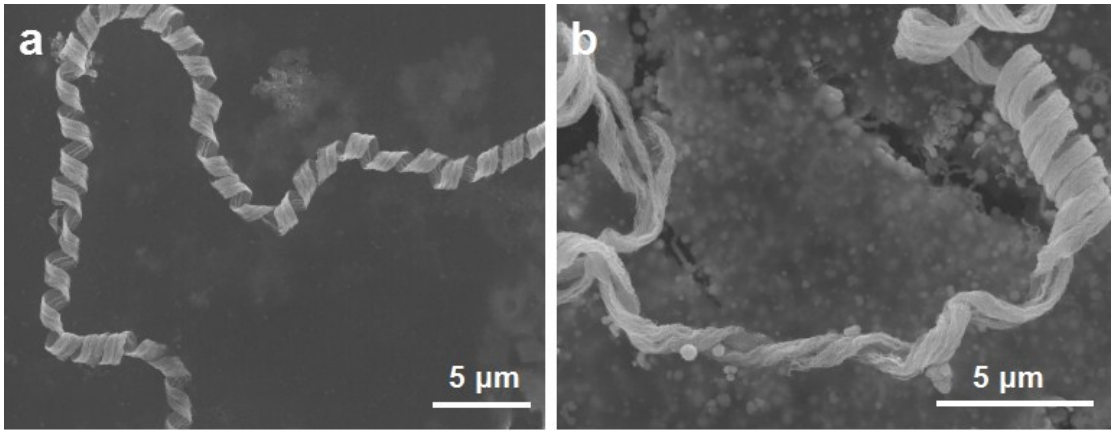

Figure S6. SEM images of (a) left- and (b) right-handed helical nanowire bundles with bundles in one sample.

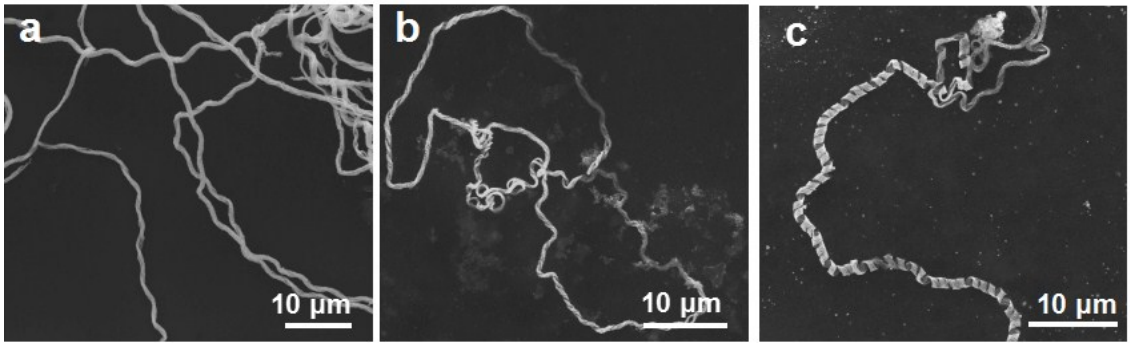

Figure S7. SEM images of the nanowire bundles formed in solvent system of (a) acetone/H_2O =1:1 (v/v), (b) N,N'-dimethylformamide/H_2O =1:1 (v/v) and (c) isopropanol/H_2O =1:1 (v/v).

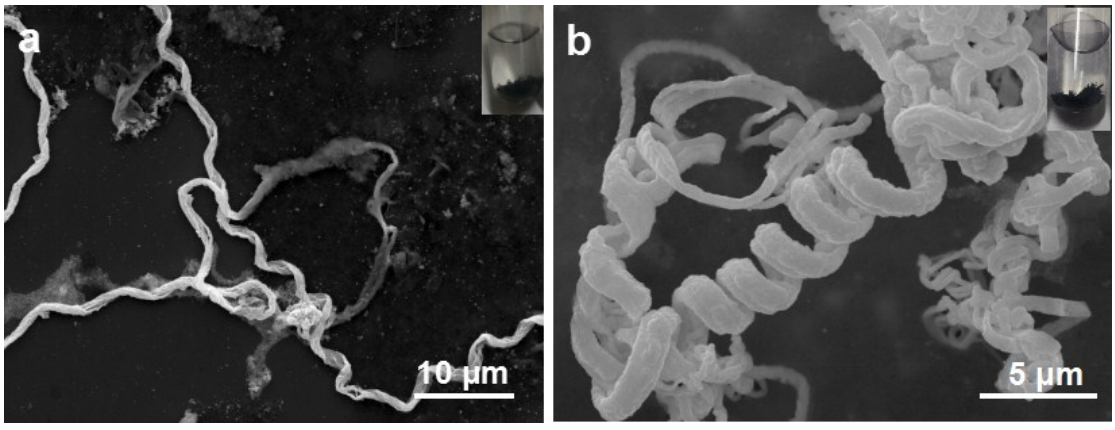

Figure S8. SEM images of the nanostructures obtained with (a) 41 mM and (b)164 mM of L-ascorbic acid.

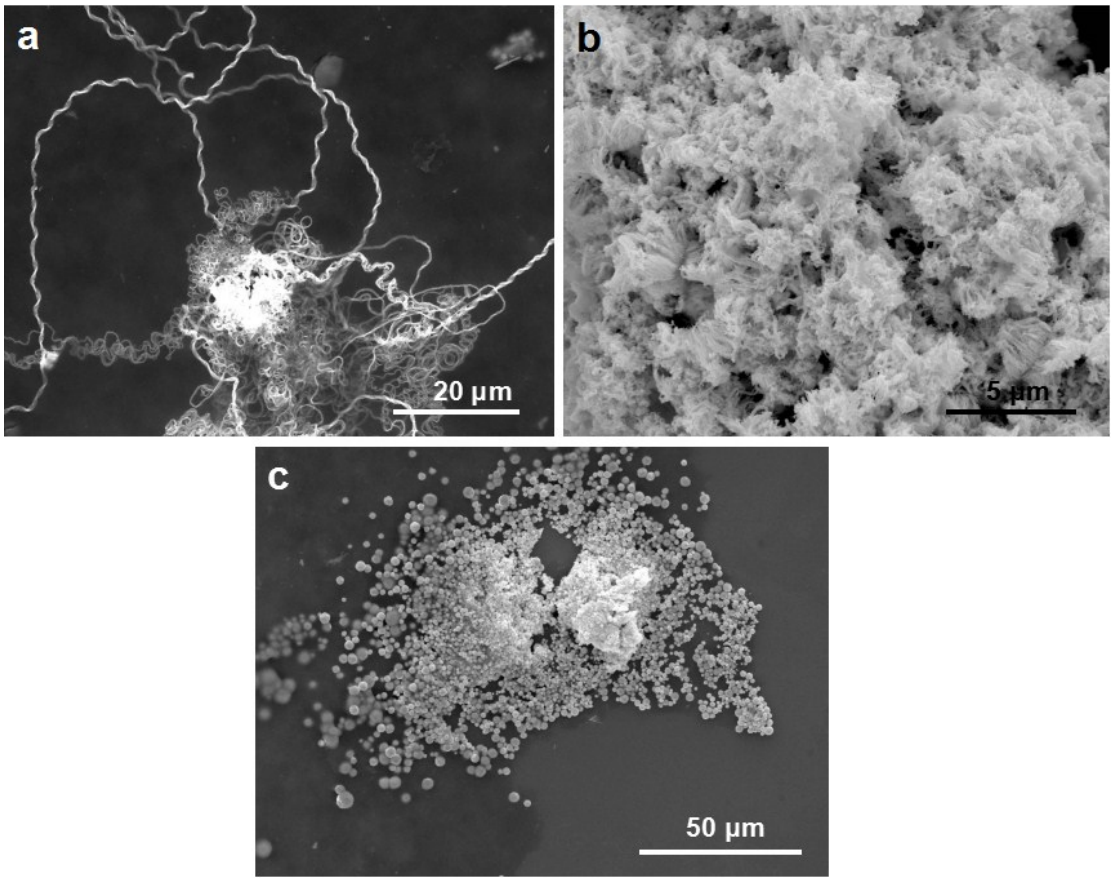

Figure S9. SEM images of the nanowire bundles obtained at (a) 4 ℃, and (b) 70 ℃ and (c) 90 ℃.

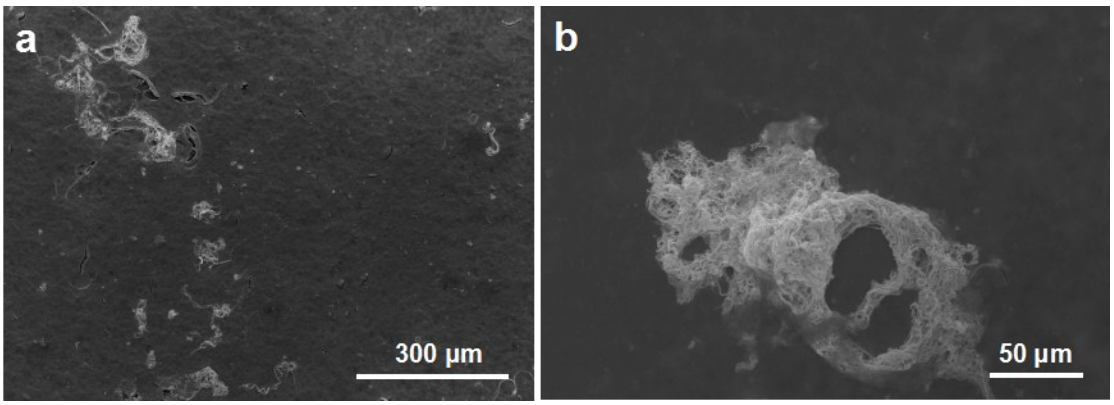

Figure S10. SEM images of the nanowire bundles obtained at the reaction on vortex.

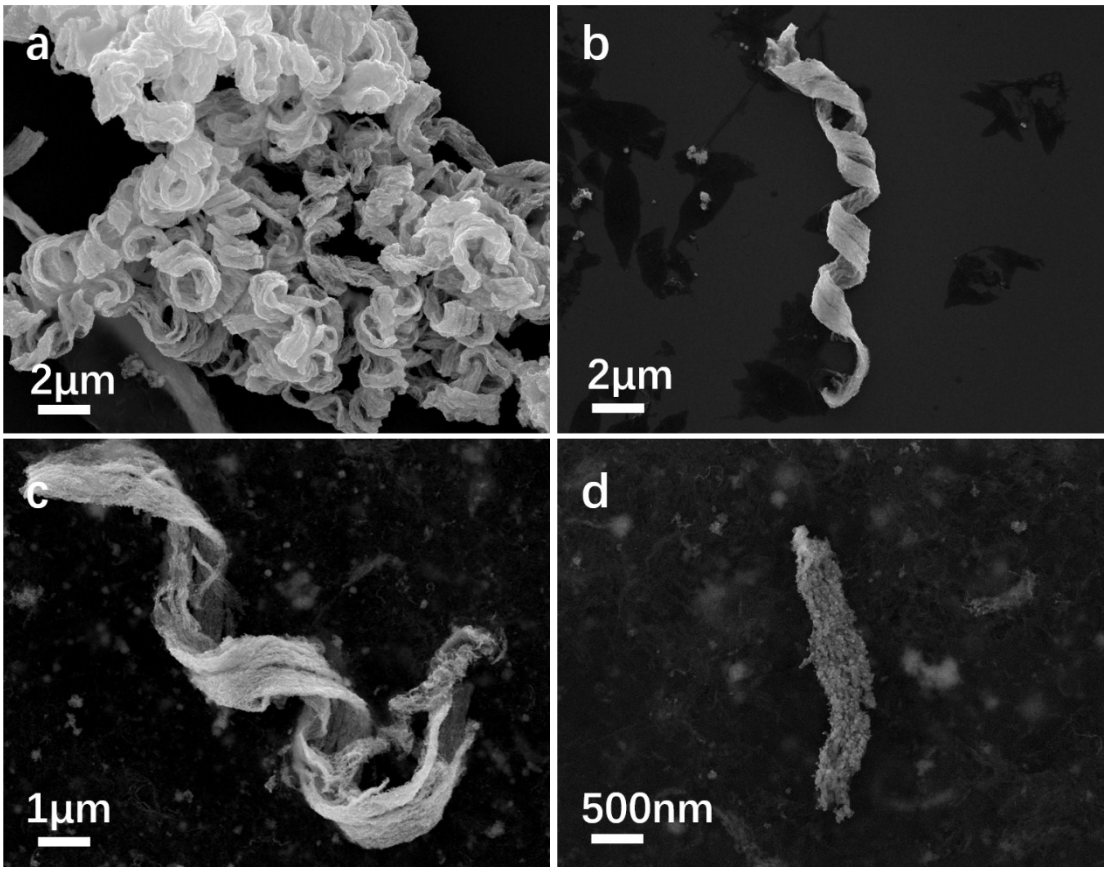

Figure S11. SEM images at different ultrasound times. a) 0 min; b) 20min; c) 40min; d) 1h.

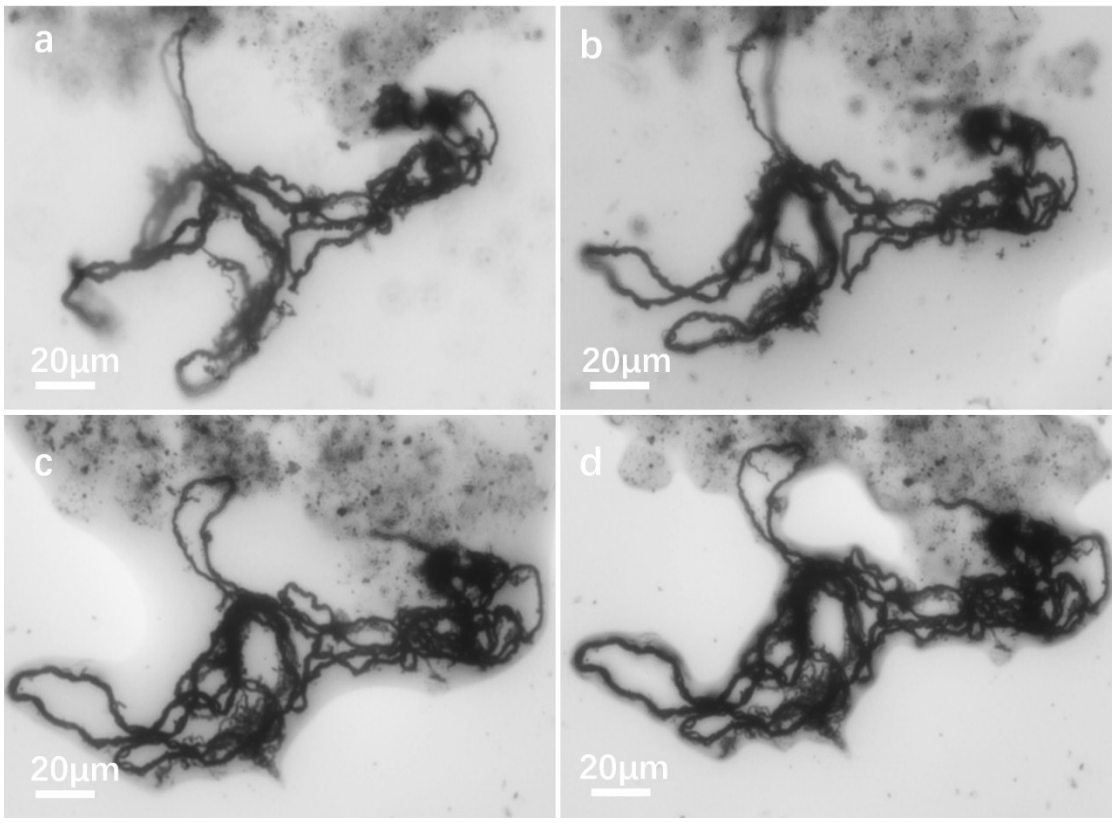

Figure S12. Optical microscope at different drying times. a) 0 min; b)10 min; c) 25 min (Semi-dry state); d) 1h (Completely dry).

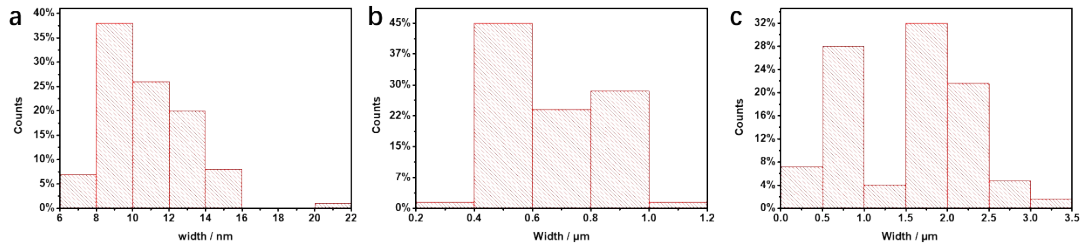

Figure S13. a) the statistical histogram of individual nanowires width, b) the statistical histogram of nanowire bundles width， c) the statistical histogram of helical nanowire bundles width