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Supplementary Information

Insulin Templated Synthesis of Singlecrystalline Silver Nanocables with Ultrathin Ag Core

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Experimental Details

1. Reagents.

All chemicals used here were of analytical grade and used without further purification. Silver sulfate (Ag₂SO₄) was purchased from Tianjin Fengchuan Chemical Co. Ltd. Sodium borohydride (NaBH₄) was purchased from Tianjin JinDongTianZheng Precision Chemical Reagent Factory. Bovine insulin was purchased from Sigma Aldrich Co. Ltd. and used as received. Wahaha mineral wate was used in all synthesis experiments.

2. Experimental section.

2.1. Preparation of insulin amyloid fibrils:

Bovine insulin (0.2 mM; Sigma) was dissolved in water adjusted to pH 1.6 with HCl, heated to 70 °C for 9 h, and then left cooling down at room temperature. This procedure yielded abundant insulin fibrils with double helix structures.

2.2. Preparation of ultrathin Ag nanocables:

Ag₂SO₄ was dissolved in water. An aged Ag₂SO₄ solution (5 mM, 100 μ L) was added to the insulin fibrils solution (0.2 mM, 200 μ L) and the mixtures were gently stirred in the shaking bath at 20 °C for 12 h. Subsequently, the solution was followed by reduction by putting a drop (30 μ L) of NaBH₄ (10 mM, 150 μ L) solution with the interval of 3 min. The mixtures had to stand still for more than 6 h in order to assure self-assembled nanocables fully grown. Finally, the silver nanocables were collected and washed with water three times. This method was very simple and reproducible and did not require post synthesis manipulation or processing.

3. Characterization.

The size and morphology of the products were examined by transmission electron microscopy (TEM; Hitachi–7650). TEM samples were prepared by placing a droplet (20 μ L) of our sample onto a 3 mm carbon–coated copper grid for 5 min.

Subsequently, the excess water evaporated at room temperature. The TEM investigations were operated at 80 kV for imaging. In order to make the hollow structure of insulin fibrils more clearly, insulin fibrils were stained with 2% PTA (phosphotungstic acid) and detected under the TEM.

The chemical composition of the products was characterized by energy–dispersive X– ray spectroscopy (EDS). EDS analysis was typically performed at an accelerating voltage of 200 kV, using an Oxford Link–ISIS X–ray EDS microanalysis system attached to TEM (JEM–2010).

High–resolution TEM (HRTEM) and selected–area electron diffraction (SAED) were employed to examine the structure of the materials. HRTEM and SAED of the products were carried out on a JEM–2010 electron microscope instrument (JEOL Ltd.) and operated at an accelerating voltage of 200 kV.

The crystalline phases were determined by X–ray powder diffraction (XRD). XRD measurement of our sample was carried out on a SmartLab X–ray diffractometer (Rigaku Ltd) to study the phases in situ. Prior to the experiment, the as–prepared silver nanocables suspensions were freeze dried in vacuum at -100 °C to collect enough dry powders for XRD analysis. The scan data were collected in the 20 range 10° -100 ° with a step size of 4 ° min⁻¹.

The insulin fibrils own a small homogeneous diameter and lengths of several micrometers were examined by atomic force microscope (AFM, Multimode-8) as well. AFM samples were prepared by placing a droplet (20 μ L) of insulin fibrils solution onto a 1 cm*1 cm mica substrate. And then, the samples were covered with beaker until the solution was evaporated at room temperature.

UV-vis absorption spectrum (UV-2550 spectrophotometer) was utilized to prove the possible detailed mechanism of silver nanocables growth based on insulin fibrils as templates. In the process, HCL (pH 1.6) acted as base fluid. The different characteristic spectrum curves of insulin fibrils solution, the mixture solution of insulin fibrils and silver precursors, silver nanocables solution were shown in Figure 2.

4. Figures.



Figure S1. Tapping mode AFM topography image of insulin amyloid fibrils deposited on a mica substrate. (a) A large sum of insulin fibrils with double helix structure. (b) Two typical assemblies with distinct double helix structure and their distribution of z height in the image are shown in (c).

AFM measurement has been carried out on the insulin fibrils template. Copious fibrils are shown in Figure S1 (a). The various shades are a result of a dense coverage of high aspect ratio assemblies extending up to several micrometers in length. Two typical fibrils in Figure S1 (b) shows a smooth double helix structure with uniform height is about 2.5 nm according to Figure S1 (c)



Figure S2. (a) Low and (b) high magnification TEM images of insulin fibril templates.



Figure S3. TEM image of silver nanocables in high dispersion after sonication.