Electronic Supplementary Information (ESI) for:

"Low temperature synthesis of ZnO nanowire by using a genetically modified collagen-like triple helix as a catalytic template"

Hanying Bai, Fen Xu, Luona Anjia, and Hiroshi Matsui*

Department of Chemistry and Biochemistry
City University of New York-Hunter College
New York, NY 10065
* hmatsui@hunter.cuny.edu

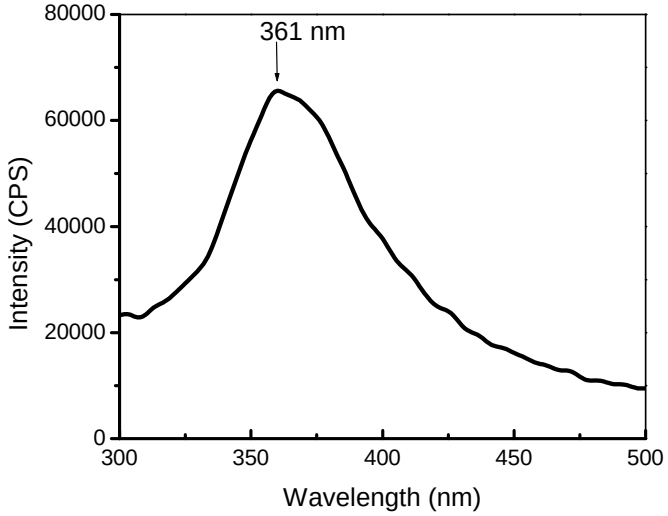
Contents:

The collagen fragments were cloned into a GPP-foldon vector built on the pET35a plasmid of Novagen (the original GPP-foldon vector was kindly provided by Dr. Jurgen Engel at University of Basel, Switzerland). The product of this plasmid is a fusion protein with 6 x His tag and thioredoxin as the carrier protein which can be removed by Thrombin cleavage to produce the chimaeric protein containing the triple helix domain and the foldon domain with the Cys-knot was inserted at the interface of the two domains. The protein was expressed in bacteria JM109 from Promega and purified by His-tag affinity column. After the His-tagged thioredoxin was removed by thrombin digestion and the second round of His-affinity column, the fragments was further purified by gel-filtration to isolate the cross-linked triple helix. The final samples are >97% pure as estimated by SDS-electrophoresis and gel-filtration experiments.

To grow ZnO nanocrystals on the F877 triple helices, we mixed 80 µl of F877 solution (0.5 mg/ml) with 55 µl of ZnO-1 peptide solution (0.1 mg/ml) for the molar ratio of 1:3. To increase the molar ratio of the ZnO-1 peptide ten times with respect to the F877 triple helix, we also prepared 55 µl of 1.0 mg/ml ZnO-1 peptide and mixed with 80 µl of F877 solution (0.5 mg/ml). These mixtures were vortexed for 10 seconds and left for 1 day at 4 °C. The ZnO-1 (Glu-Ala-Val-Met-His-Lys-Val-Ala-Pro-Arg-Pro-Gly-Gly-Gly-Ser-Cys) was purchased from GenScript Co., NJ. To adjust pH of the solution, we added 300 µl of 0.2 mol/l Tris buffers in pH

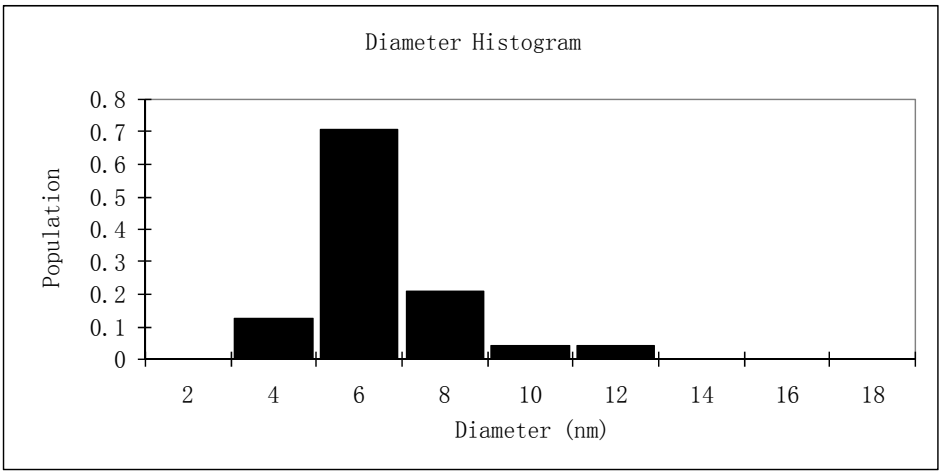
4.0, 7.0, 8.0, 10.0, respectively and vortexed for 10 seconds. After pH of solution was confirmed by pH meter, 4.2 mg of zinc acetate dihydrate ($Zn(Ac)_2 \cdot 2H_2O$, Sigma Aldrich Co.) was added into the solution with respective pH. To minimize the fluctuation of the reaction temperature, we prepared and mixed all peptide solutions and buffer solutions at consistent 4 °C. After nine days, we centrifuged the solution under 12,000 rpm for 10 minutes and separated 3 μl supernatant to extract the ZnO-coated triple helix peptides. The supernatant was dropped onto carbon-coated nickel TEM grids and the excess solution was dried by filter papers. The dried TEM grids were then examined by TEM (Zeiss EM 902) at acceleration voltage of 80 kV for low-resolution imaging. HRTEM of the samples was imaged by FEI Tecnai 20 at the acceleration voltage of 200 kV. The electron diffraction patterns and energy-dispersive X-ray spectroscopy (EDS) were taken by JEOL-TEM2200FS.

2. Photoluminescence spectrum of the triple helix peptide-templated ZnO nanowires. The characteristic band gap of ZnO at 361 nm was confirmed by its photoluminescence spectrum.



3. The histograms for the size distribution of ZnO nanowires. These histograms for the diameter (a) and the length (b) were obtained by averaging 100 nanowires in TEM images, and their average diameter was 6 nm and average length was 40 nm.

(a) The histogram for the diameter of the ZnO nanowires.



(b) The histogram for the length of the ZnO nanowires.