Supporting Information

A novel bacteria-templated sonochemical route for the *in situ* one-step synthesis of ZnS hollow nanostructures

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Experimental

Lactobacillus powders contain mainly of *Streptococcus thermophilus* (*Str. thermophilus*) and *Lactobacillus bulgaricus* (*L. bulgaricus*). Zinc acetate [$\text{Zn}(\text{ac})_2$] and thioacetamide (TA) were used as received without further purification. Ultrasonic irradiation was provided with an ultrasonic cleaner (with maximum acoustic power of 360 W, frequency of 59 KHz).

In a typical procedure, $\text{Zn}(\text{ac})_2$ (110 mg), TA (37.5 mg) and Lactobacillus powder (1 g) were dispersed in deionized water (50 ml), then the mixture was sonicated with a ultrasonic cleaner at room temperature for 6 h under ambient air. The resulting white powder was recovered by centrifugation, washed repeatedly with distilled water and ethanol, and then dispersed in ethanol for characterization.

The samples were examined by x-ray diffraction (XRD) measurements using a Bruker-AXS D8 Advance instrument operating at a voltage of 40 kV and a current of 40 mA with Cu $\text{K}\alpha$ radiation ($\lambda=1.5406\text{\AA}$). The investigation of the morphologies and microstructures was carried out using FESEM (Sirion 200) operated under 5.0 Kv (SE 3.0; WD 5mm). Transmission electron microscopy (TEM) images were obtained on a JEOL JEM-2010 instrument.

Figure S1. TEM/EDS analyses (a) original template. (b) cell/ZnS core-shell structures after 3hr of sonication. (C) ZnS hollow spheres. The cell inclusions have been removed mostly while some biological components on the cell surfaces (cell wall, S-layer, teichoic acids, etc.) probably have been extremely stabilised by the nanoparticles since they have strong interaction with precursors, thus they are likely to be bound within the interior of ZnS shells. However, the content of these biological components is very small which can be neglected.

Figure S2.(a) ZnS nanoparticles deposited on the cell surfaces at the beginning. (b) ZnS nanoclusters partially coated cells following the (a) stage.

Figure S3. XRD patterns of (a) pure ZnS nanoparticles prepared under the same condition but without biotemplate. (b) ZnS hollow spheres with the presence of cellular fragments. The XRD pattern of pure ZnS nanoparticles prepared without biotemplate shows the presence of broad peaks (Supplementary Information, Fig. S3a), corresponding to the zinc blende crystal structure. The three diffraction peaks correspond to the (111), (220), and (311) planes of the cubic crystalline ZnS. The XRD profile of the ZnS hollow structures (Supplementary Information, Fig. S3b) shows the presence of weak diffraction peaks. The peak positions of ZnS hollow structures matches with the bare ZnS nanoparticles. The presence of weak XRD peaks in the latter sample can be attributed to the partial crystalline nature of ZnS and to the presence of organic residues released from cells.