Electronic Supplementary Information for:

**Thiol-based non-injection synthesis of near-infrared Ag$_2$S/ZnS core/shell quantum dots**

Peng Jiang,‡ Rong Wang,‡ Zilin Chen*

*Email: chenzl@whu.edu.cn

**The quantum yield (QY) measurement**

The QY of the as-prepared QDs were measured using indocyanine green (ICG) as a reference standard (QY =13% in DMSO). The absorption spectra of the ICG and QDs solutions at different concentrations were recorded, the optical densities at their excitation wavelength were below 0.1 to avoid self-absorption effects. Then, the fluorescence spectra of these samples were recorded at the same under identical conditions. The QY was calculated according to the following equation:

$$\Phi_{QD} = \Phi_{Dye} \left( \frac{Grad_{QD}}{Grad_{Dye}} \right) \left( \frac{\eta_{QD}^2}{\eta_{Dye}^2} \right)$$

Where $\Phi_{Dye}$ is the fluorescence QY of ICG, $Grad$ is the gradient from the plot of integrated fluorescence intensity vs absorbance at excitation wavelength (600 nm), and $\eta_{QD}$ and $\eta_{Dye}$ are the refractive indexes of the solvents for ICG and Ag$_2$S quantum dots, respectively.
Fig. S1 Integrated fluorescence intensity vs. optical density (absorbance) of (a) Ag$_2$S QDs and (b) Ag$_2$S/ZnS QDs in chloroform and (c) ICG in DMSO.

Fig. S2 The excitation spectrum (a), absorption spectrum (b) and PL spectrum (c) of the Ag$_2$S/ZnS QDs.
**Fig. S3** The size distribution histograms of the Ag\textsubscript{2}S (a) and Ag\textsubscript{2}S/ZnS QDs. The size distribution histograms were obtained by measuring the diameter of about 1000 particles in TEM image.

**Fig. S4** The TEM image (a), absorption spectrum (b, black line) and PL spectrum (b, red line) of the Ag\textsubscript{2}S QDs synthesized using 1-Dodecanethiol (CH\textsubscript{3}(CH\textsubscript{2})\textsubscript{10}CH\textsubscript{2}SH) as both ligand and sulfur source.
Fig. S5 The TEM image of the Ag$_2$S QDs synthesized using 1-Hexadecanethiol (CH$_3$(CH$_2$)$_{14}$CH$_2$SH) as both ligand and sulfur source.

Fig. S6 The PL spectra (a) and the corresponding absorption spectra (b) of the Ag$_2$S and Ag$_2$S/ZnS QDs synthesized using 1-Hexadecanethiol (CH$_3$(CH$_2$)$_{14}$CH$_2$SH) as both ligand and sulfur source.
Fig. S7 Photographs of Pb(Ac)$_2$ testing papers for the H$_2$S detection after exposed to the reaction atmosphere for 30 min under different temperatures; (a) ODE and 1-octanethiol in the reaction flask; (b) Only ODE in the reaction flask.

Fig. S8 Photographs and grayscale plot of Pb(Ac)$_2$ testing papers for the H$_2$S detection after exposed to the reaction atmosphere for 30 min under different temperatures (Only ODE in the reaction flask).
Fig. S9 Hydrodynamic size of the water-soluble Ag$_2$S/ZnS QDs measured by DSL.