Supporting Information

Quantitative SERRS Multiplexing of Biocompatible Gold Nanostars for *in vitro* and *ex vivo* detection

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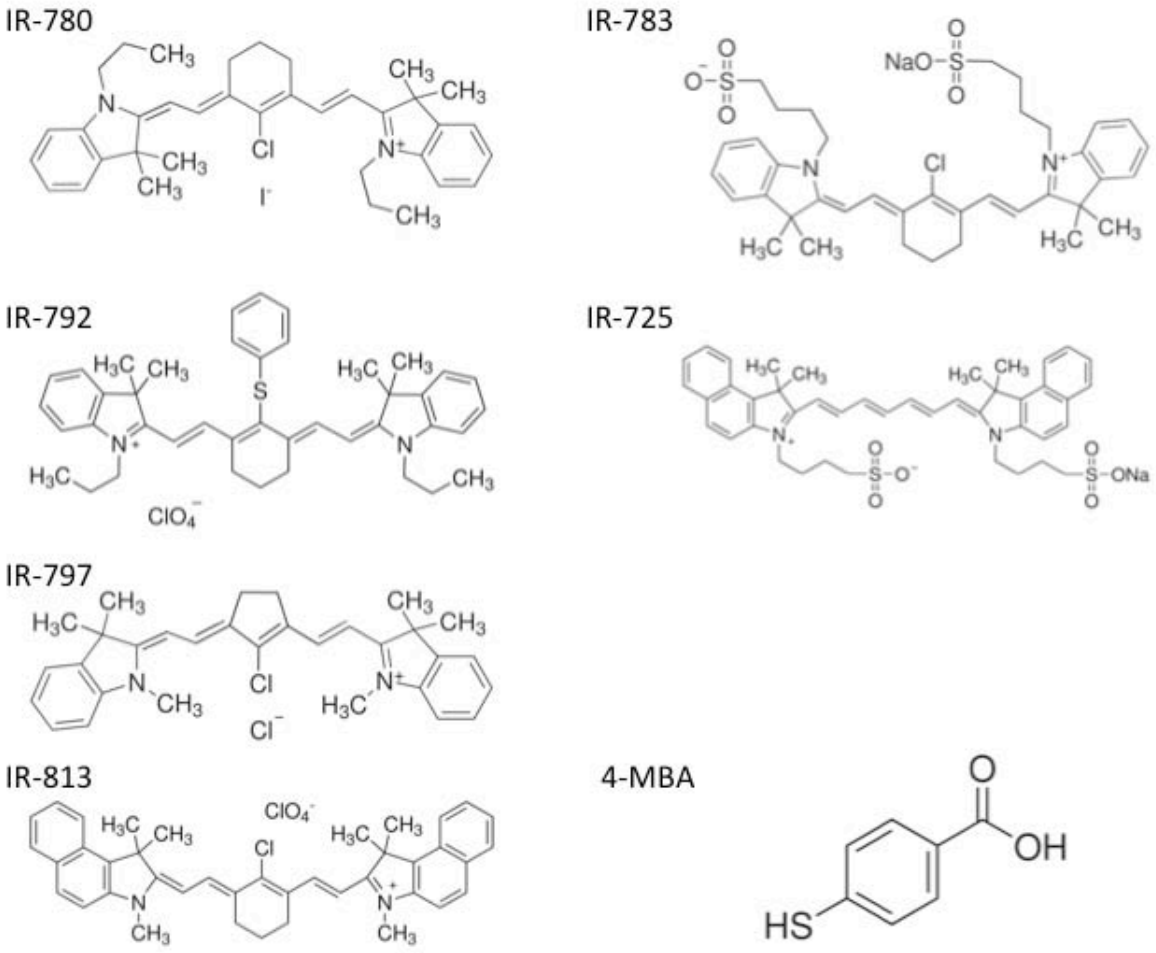

Figure S 1. Chemical structure of the dyes used in this study.

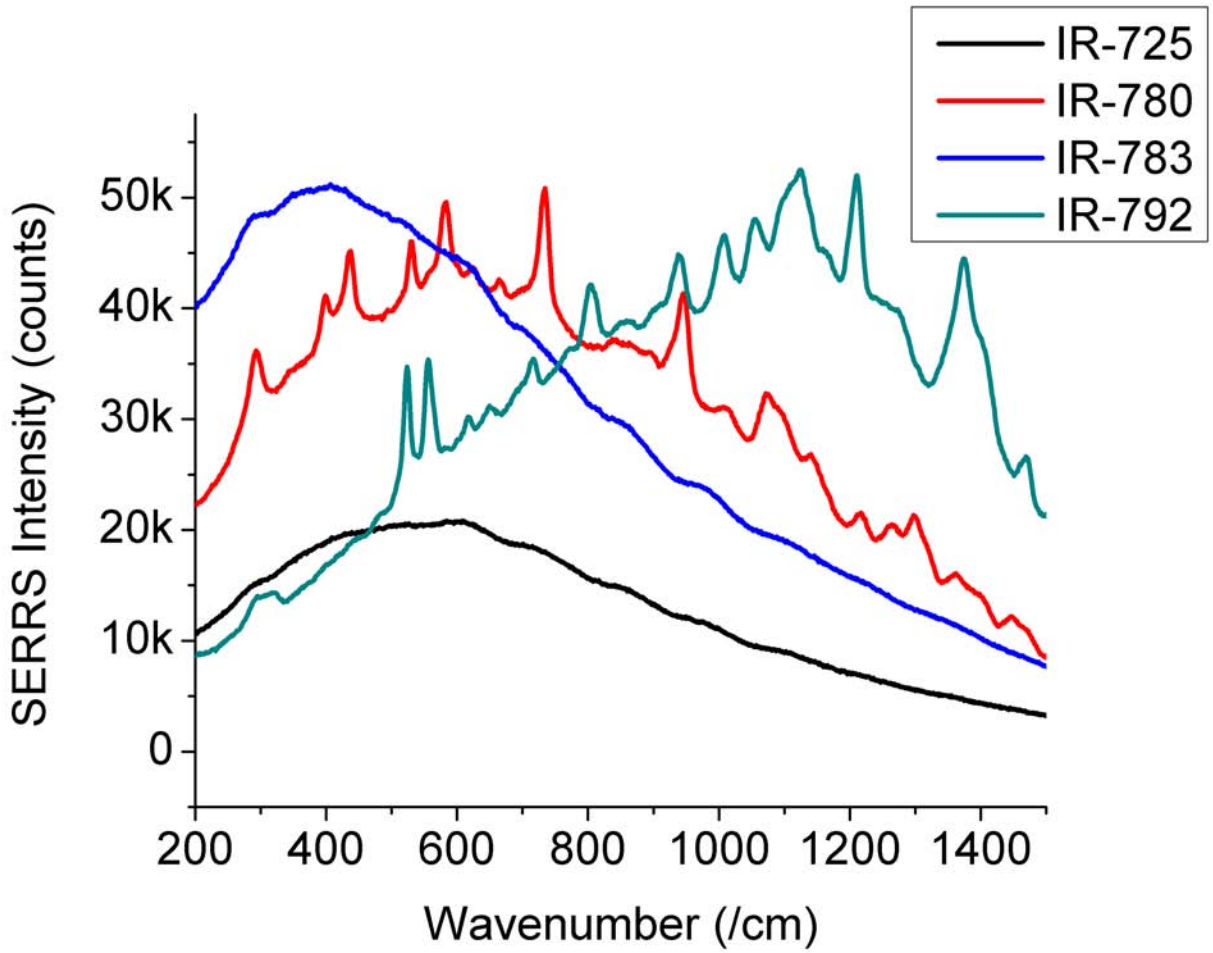

Figure S 2. Unmodified SERRS spectra from two positively-charged NIR dyes (IR-780, IR-792) and two negatively-charged NIR dyes (IR-725, IR-783) on SDS-coated nanostars. The spectra were collected under 785 nm excitation (100 mW, 100 msec, 10 averages).

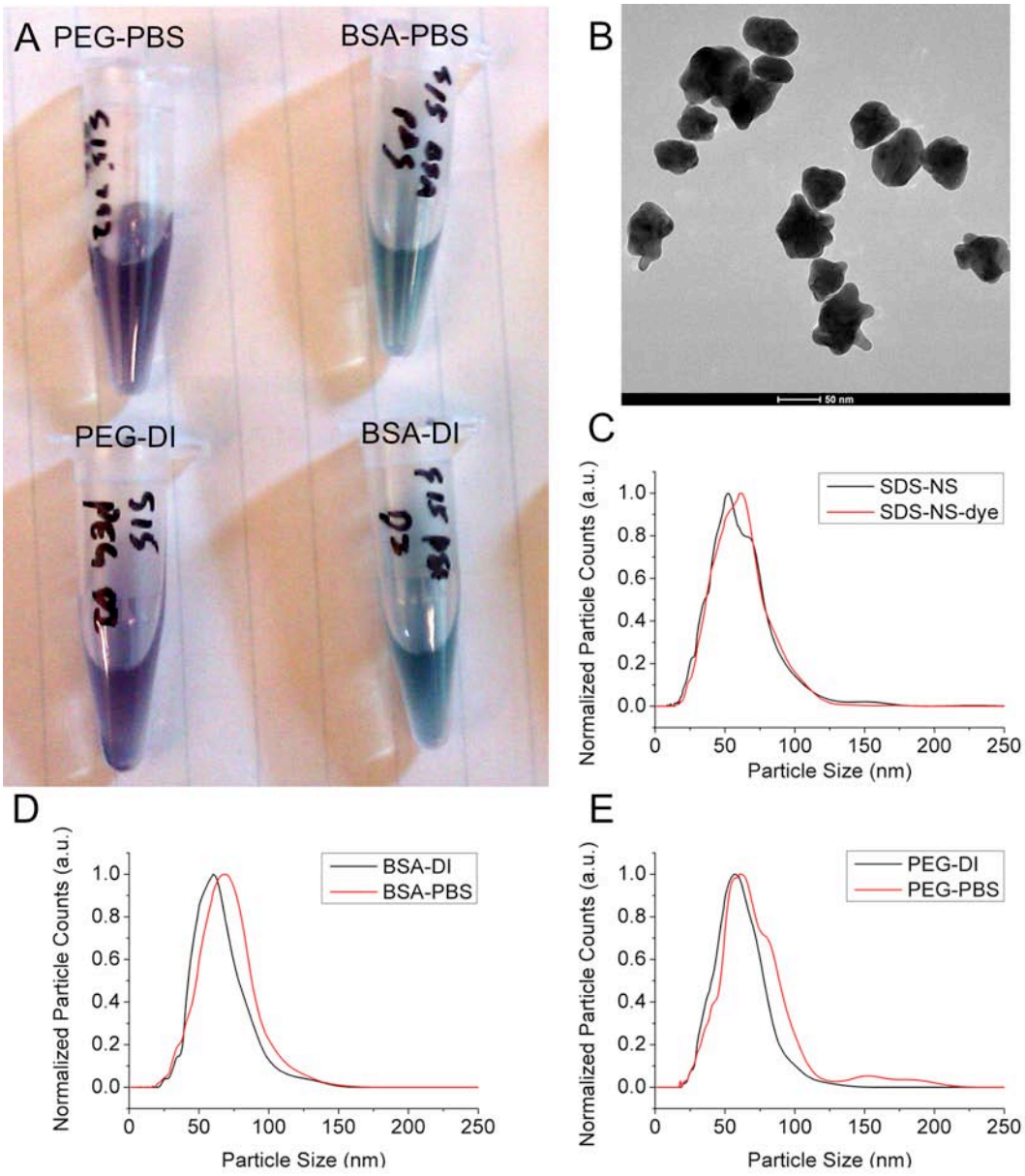

Figure S3. NIR-SERRS probe stability investigation. The SDS-coated NIR dye-labeled NS were protected with PEG and BSA, then washed once and resuspended into PBS. (A) Geometry stability. Photograph of the NIR-SERRS probe solutions after one day at room temperature. Originally, all solutions were green in color. After a day, the BSA group retained the color but the PEG group had purple discoloration. Such discoloration is a result of the blue-shifted plasmon suggesting a reshaping of nanoparticles towards a less spiky but more spherical geometry (B). BSA, by contrast, protects the nanostars from reshaping. Steric stability. Particle size distribution of the (C) SDS-coated NS and SDS-coated NS with dye, and (D-E) BSA and PEG protected NIR-SERRS probes washed once in DI or PBS then resuspended in the same solution. While BSA maintained the probes' monodispersity after washing (D), PEG resulted in slight aggregation when washed in PBS (E). A slight average size enlargement without forming large aggregate was observed on the BSA-PBS group.

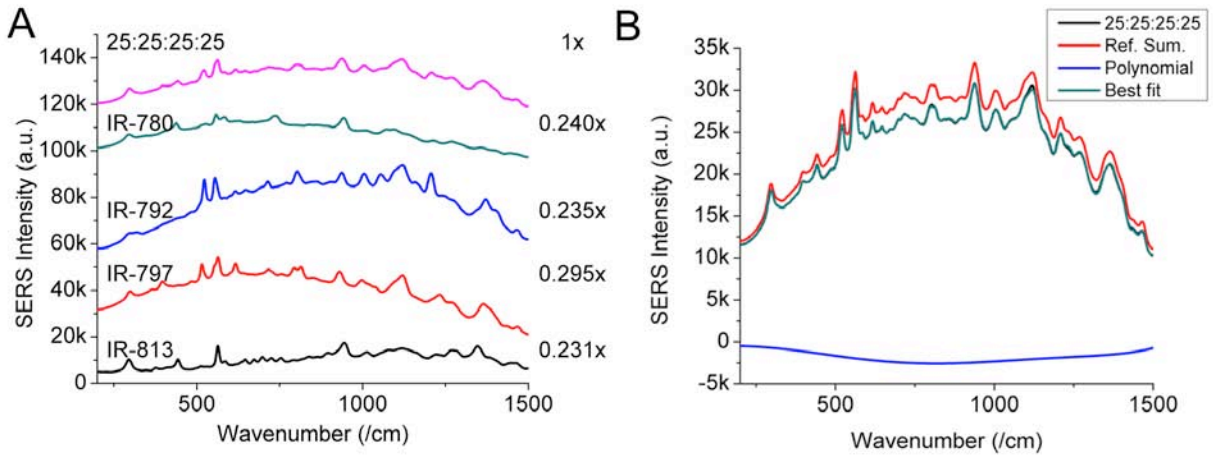

Figure S4. Spectral decomposition for *in vitro* quantitative SERRS multiplexing. (A) Unmodified spectra (offset) of the mixture (ratio 25:25:25:25) and the 4 references (IR-780, IR-792, IR-797, IR-813). The decomposition is based on the assumption that the mixture spectrum comprises of references spectra and an unknown polynomial. The computational fitting process will determine the contribution of each reference (*i.e.* signal fraction), which is listed on the right. The range for spectral fitting was from 200 to 1500 wavenumbers. (B) The best fit spectrum (green) is the result of the summation of signal fractions from each reference (Ref. Sum.; red) plus a free-fitting 7-order polynomial (blue). The best fit (green) showed a good fit to the original measured spectrum (black) with an error (the average difference between best-fitted and original spectra) of 0.37%. The data was collected under 785 nm excitation (200 mW, 500 ms, 10 averages).

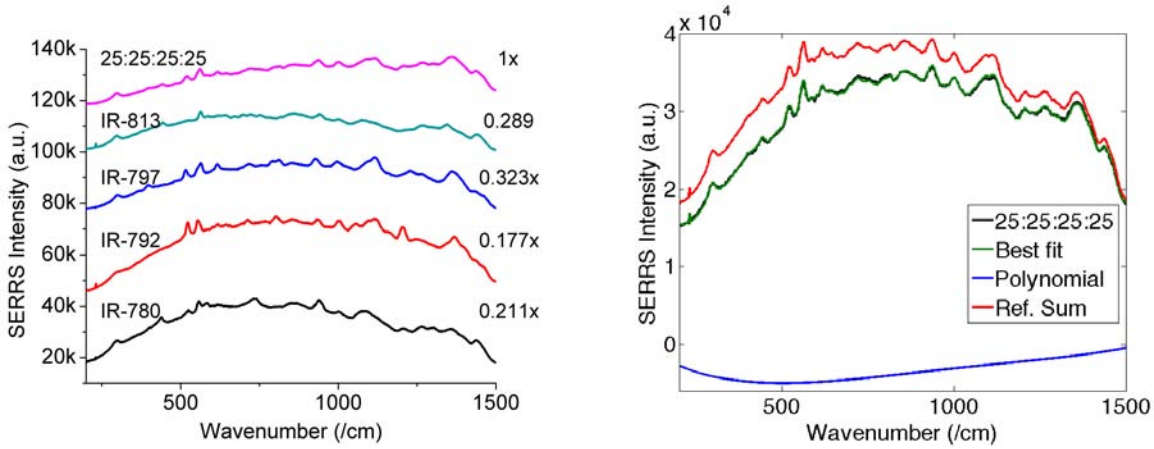

Figure S5. Spectral decomposition for *ex vivo* quantitative SERRS multiplexing. (Left) Unmodified spectra (offset) of the mixture (ratio 25:25:25:25) and the 4 references (IR-780, IR-792, IR-797, IR-813) collected through a layer of skin. (Right) The best fit spectrum (green) is the result of the summation of signal fractions from each reference (Ref. Sum.; red) plus a free-fitting 7-order polynomial (blue). The best fit (green) showed a good fit to the original measured spectrum (black) with an error of 0.44%. The data was collected under 785 nm excitation (400 mW, 10 s, 1 accumulation).