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## **Supporting Information**

## Upconversion fluorescent nanoprobe based on 4-NP reversible structure

## for a wide range of pH determination

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Fig. S1 FT-IR spectra of core@shell and core@shell@SiO<sub>2</sub>@4-NP nanocrystals



Fig. S2 UV-visible absorption spectra of 4-NP (50 µM) at different pH conditions.



Fig. S3 UV-visible absorption spectra of core@shell@SiO<sub>2</sub>



Fig. S4 UV-visible absorption spectra of 4-NP (50  $\mu$ M) at different pH conditions.



Fig. S5 Upconversion fluorescence spectra of core and core@shell nanomaterials under 980 nm excitation.



Fig. S6 Normalized upconversion fluorescence emission spectra of core@shell@SiO<sub>2</sub>@4-NP in different pH under 980 nm excitation with the same power.



Fig. S7 UV-vis absorption spectra of the reversibility of 4-NP solution in alkaline and acidic solutions (at pH= 2.0, pH= 10.0).