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## Supplemental information:

Fig.S1 Brief schematic diagram of synthetic route of Co<sub>3</sub>O<sub>4</sub> nanostructures

Fig.S2 Typical cross-section view SEM images of (a) Co<sub>3</sub>O<sub>4</sub> NSs, (b) Co<sub>3</sub>O<sub>4</sub> NPs and

(c) Co<sub>3</sub>O<sub>4</sub> NCs

Fig.S3 Mott-Schottky plots of Co<sub>3</sub>O<sub>4</sub> nanostructures

Fig.S4 Band gap of Co<sub>3</sub>O<sub>4</sub> nanostructures

Fig.S5 Brief schematic diagram of synthetic route of Co<sub>3</sub>O<sub>4</sub>/Sb<sub>2</sub>S<sub>3</sub> heterojunctions

Fig.S6 Mott-Schottky plots of Co<sub>3</sub>O<sub>4</sub>/Sb<sub>2</sub>S<sub>3</sub> heterojunctions

Fig.S7 Band gap of Co<sub>3</sub>O<sub>4</sub>/Sb<sub>2</sub>S<sub>3</sub> heterojunctions



Fig.S1 Brief schematic diagram of synthetic route of Co<sub>3</sub>O<sub>4</sub> nanostructures



Fig.S2 Typical cross-section view SEM images of (a)  $Co_3O_4$  NSs, (b)  $Co_3O_4$  NPs and (c)  $Co_3O_4$  NCs



Fig.S3 Mott-Schottky plots of Co<sub>3</sub>O<sub>4</sub> nanostructures



Fig.S4 Band gap of Co<sub>3</sub>O<sub>4</sub> nanostructures



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