Electronic Supplementary Material (ESI) for Lab on a Chip.

1. Synthesis of Au NR@TiO_2 core-shell, Au NR-TiO_2 dumbbell structure in a batch reactor

To begin with, 0.5 mL of pre-prepared gold nanorods (Au NRs) were dispersed in 2 mL of water and subjected to five minutes of ultrasonication to ensure effective dispersion. Subsequently, 200 µL of $TiCl_3$ was diluted in 4 mL of H_2O. In order to control the hydrolysis degree of $TiCl_3$ and obtain varying amounts of TiO_2, different volumes of 0.5 M $NaHCO_3$ solution were added dropwise to the reaction solution with continuous stirring. The Au NRs solution was then immediately injected. The resulting mixture was stirred at room temperature for 30 minutes, yielding a series of Au-TiO_2 nanostructures with distinct morphologies. As the concentration of $NaHCO_3$ decreased, the Au-TiO_2 nanocomposites could transform from a core-shell structure to a dumbbell structure. Finally, the samples were collected, washed twice with ethanol, and dispersed in deionized water.

When synthesized in a beaker, the concentration of sodium bicarbonate solution was 1 M. SEM images of the synthesized Au-TiO_2 nanostructures are shown below (Figure S1). Figure S1a shows the thick Au NR-TiO_2 core-shell structure synthesized with 1500 µl of $NaHCO_3$ solution, while figure S1b shows the thin Au NR-TiO_2 core-shell structure synthesized with 1440 µl of $NaHCO_3$ solution. The SEM images indicate that by varying the amount of sodium bicarbonate solution, the thickness of the outer TiO_2 layer of the Au NR-TiO_2 core-shell structure can be controlled.

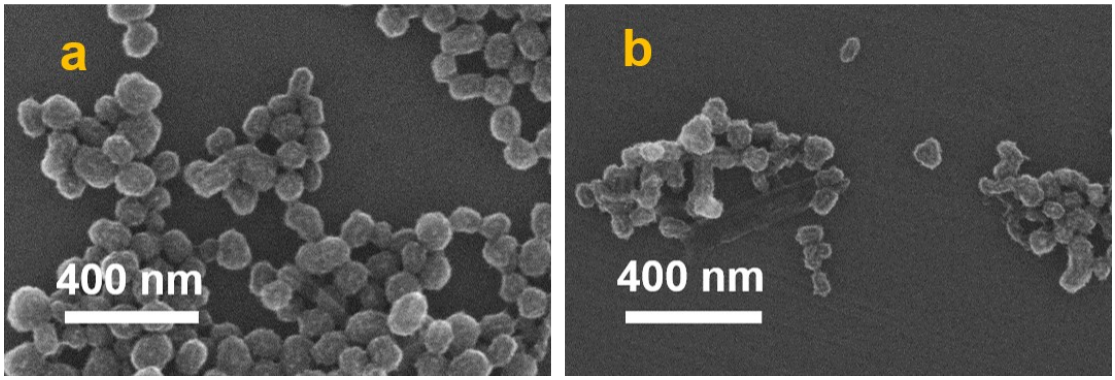

Figure S1. SEM images of Au NR@TiO_2 core-shell nanocomposites with decreasing amount of $NaHCO_3$. (a) Au NR@thick-TiO_2, $NaHCO_3$:1500 µL; (b) Au NR@thin-TiO_2, $NaHCO_3$:1440 µL;

As the amount of $NaHCO_3$ solution is further reduced, SEM images reveal a transition of the Au NR-TiO_2 nanocomposite structure from a core-shell morphology to dumbbell-like structure. Moreover, as the volume of $NaHCO_3$ continues to decrease, the TiO_2 at both ends of the dumbbell-shaped Au NR-TiO_2 structure also decreases. The $NaHCO_3$ volumes for Figures S2a, b, and c are 1380 µL, 1320 µL, and 1260 µL, respectively.

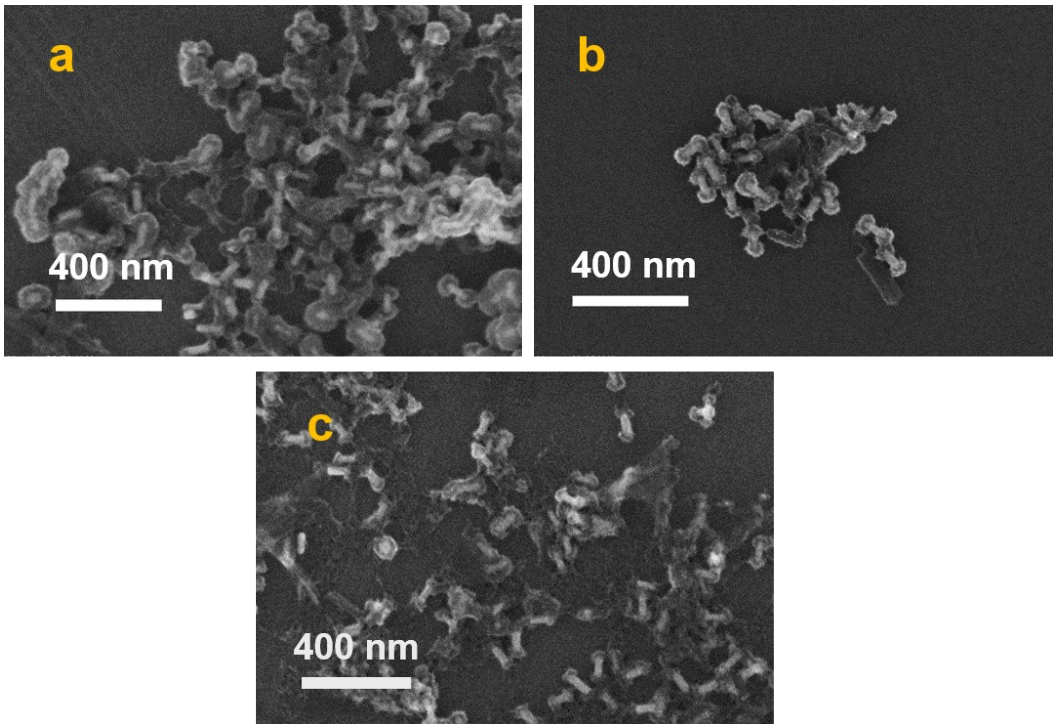

Figure S2. SEM images of Au NR-TiO_2 dumbbell-like nanocomposites with decreasing amount of $NaHCO_3$: (a) 1380 µL; (b) 1320 µL; (c) 1260 µL.

2. Synthesis of Au NR-TiO_2 dandelion structure in a batch reactor

To start, 0.2M CTAB solution was added to 1.3 mL of water, followed by the addition of 0.5 mL of pre-prepared gold nanorods (Au NRs), and subjected to five minutes of ultrasonication for dispersion. Subsequently, 200 µL of $TiCl_3$ was diluted in 4 mL of H_2O, then 700 µL of 1M $NaHCO_3$ solution was added dropwise to the $TiCl_3$ solution with continuous stirring. The pre-prepared CTAB-Au NRs solution was then immediately added, and the mixture was stirred at room temperature for half an hour. Finally, the samples were washed twice with ethanol and dispersed in deionized water.

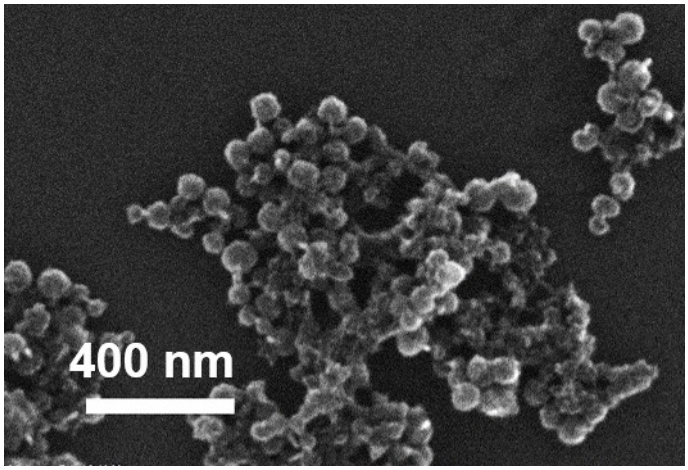

Figure S3. SEM images of Au NR-TiO_2 dandelion-like nanocomposites with decreasing amount of $NaHCO_3$ (700 µL).

3. Morphological characterization after photocatalysis

Figure 4 shows the SEM images of the core-shell and dumbbell structures of Au NR-TiO_2 after photocatalysis. Based on the analysis of SEM images, it can be observed that the overall morphology of the Au NRs-TiO_2 nanocomposites remains unchanged before and after catalysis.

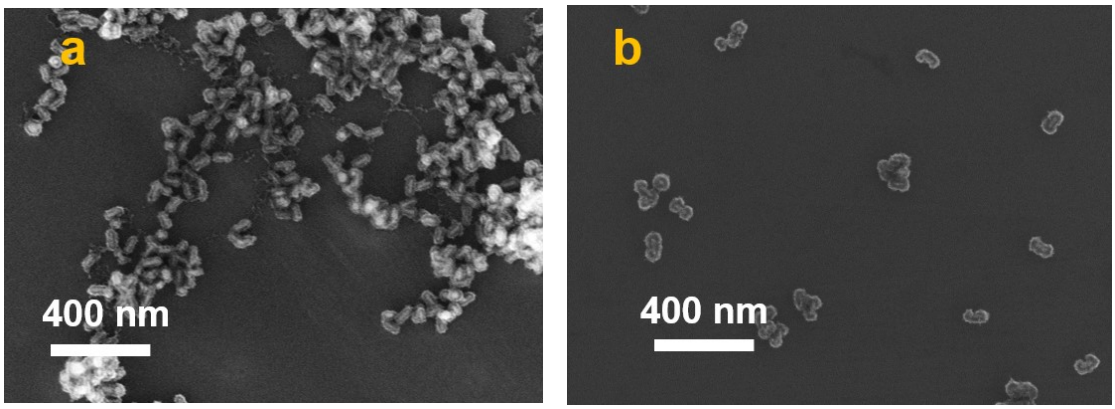

Figure S4. SEM images of the core-shell (a) and dumbbell (b) structures of Au NR-TiO_2 after photocatalysis

4. X-Ray Diffraction (XRD) result

The XRD pattern provides further evidence for the formation of TiO_2 shell crystals only the typical diffraction peaks indicating that the TiO_2 shell is amorphous.

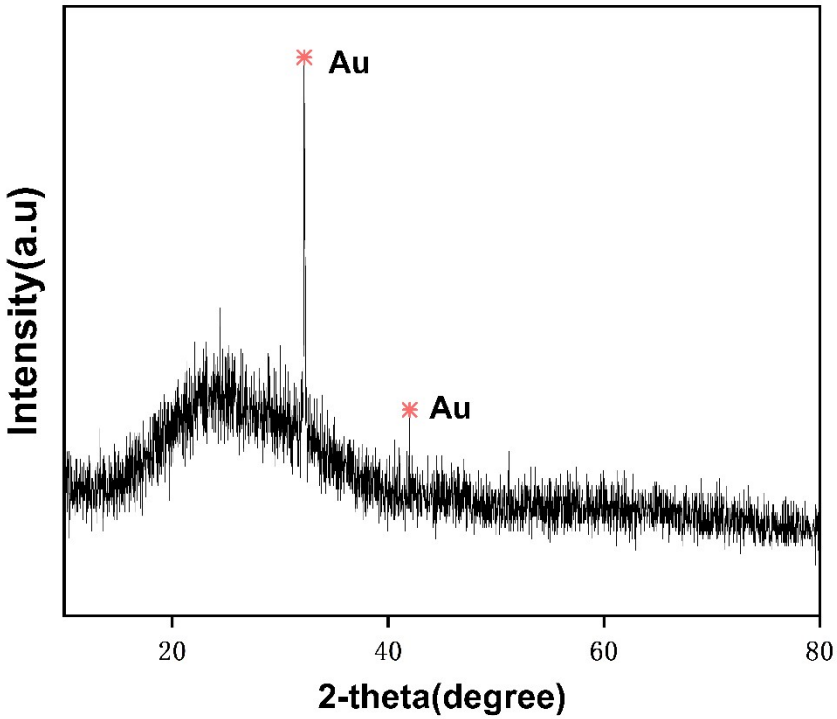

Figure S5. XRD result of Au NR@TiO_2 core-shell nanostructures