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† Electronic Supplementary Information

1. Preparation of (Y, Gd)(OH)CO_3 and (Y, Gd)(OH)CO_3:Ln^{3+} (Ln = Eu, Yb, Er, and Ho) Nanoparticles

Typically for Y(OH)CO_3, Y_2O_3 (0.2216 g) was dissolved in dilute HNO_3 solution (1:1 v/v) by heating to 80 °C with agitation to form clear $Y(NO_3)_3$ aqueous solution. Superfluous HNO_3 was evaporated by continuous heating until the pH value of the $Y(NO_3)_3$ solution reaches about 4. The urea (3.0 g) was dissolved in deionized water (30 mL), then added the above $Y(NO_3)_3$ solution (30 mL) drop by drop. The mixture was stirred continuously at room temperature for half an hour, and then heated to 90 °C for 2 h in the water bath. The resulting suspension was separated by centrifugation and collected after washing with deionized water for three times. The Ln^{3+} (Ln = Eu, Yb, Er, and Ho) doped Y(OH)CO_3 were prepared by the same procedures except that a stoichiometric amount of $Ln(NO_3)_3$ was added to $Y(NO_3)_3$; the preparations of matrixes and Ln^{3+}-doped ($Y_{0.5}$, $Gd_{0.5}$)(OH)CO_3 and Gd(OH)CO_3 also adopted the same route.

2. Preparation of Monodisperse Ellipsoid-like Hollow YVO_4 and YVO_4:Ln^{3+} (Ln = Eu, Yb, Er, and Ho)

For a typical YVO_4 synthesis, the as-obtained Y(OH)CO_3 precursor was dispersed into 10 ml of deionized water by ultrasonic. Then NH_4VO_3 (0.2319 g) was dissolved in deionized water (10 ml) with stirring and heating, and dripped into the above suspension followed by further stirring. After the mixture was agitated at 70 °C for half an hour, the final pH value was measured to be about 7.5. Then it was transferred into a Teflon bottle held in a stainless-steel autoclave and heated at 200 °C for 12 h. After cooling down naturally to room temperature, the product was separated from the reaction media by centrifugation, washed several times with deionized water and ethanol, and finally dried overnight at 50 °C. The power yield ratio was calculated to be as high as 90%. The Ln^{3+} (Ln = Eu, Yb, Er, and Ho) doped YVO_4 hollow ellipsoids were prepared by the same procedure except for using Y(OH)CO_3:Ln^{3+} as precursors.

3. Preparation of Mesoprorous (Y, Gd)VO_4/(Y, Gd)VO_4:Ln^{3+}@nSiO_2@mSiO_2 (Ln = Eu, Yb, Er, and Ho) with Amino-Modification

Specifically for YVO_4@nSiO_2@mSiO_2, the as-prepared YVO_4 sample (0.1 g) was treated with ethanol by ultrasonication for half an hour, which was then separated by centrifugation and dispersed in a mixture of ethanol (40 mL), deionized water (10 mL), and concentrated ammonia aqueous solution (28 wt%, 0.5 mL). TEOS (0.03 g) was added dropwise to the above suspension. After stirring for 5 h, the products were separated by centrifugation and washed with ethanol and water, and then redispersed in a mixed solution containing CTAB (0.15 g), deionized water (40 mL), concentrated ammonia aqueous solution (28 wt%, 0.5 mL), and ethanol (30 mL). When the resulting solution was stirred for half an hour, TEOS (0.15 g) was added dropwise with stirring. After another 5 h, the products were collected and separated by centrifugation, washed with ethanol and water several times, then dried overnight at 50 °C. The structure-template CTAB was removed by refluxing in ethanol solution of ammonium nitrate (NH_4NO_3/C_2H_5OH, 10 mg mL^{-1}) for 8 h at 80 °C. The preparations of other samples followed the same procedures.

Typically for the amino-modification of YVO_4@nSiO_2@mSiO_2, the as-prepared sample of YVO_4@nSiO_2@mSiO_2 (0.15 g) was dispersed into methylbenzene (50 mL) containing triethylamine (0.1 mL) and 3-aminopropyltriethoxysilane (0.5 mL). The above suspension was refluxed at 105 °C for 12 h, then separated by centrifugation, washed with methylbenzene and ethanol several times. The final products were dried overnight at 50 °C, and denoted as YVO_4@nSiO_2@mSiO_2-NH_2. The amino-modification for other core-shell structural samples followed the same procedures.

4. In Vitro Cytotoxicity and Morphological Observation

4.1 Cell Culture

Hela and 293T cells (5 × 10^5 cells mL^{-1}) were maintained in Dulbecco's minimum Essential medium (DMEM Hyclone) supplemented with 10% fetal bovine serum (FBS, Hyclone) and incubated in 5% CO_2 at 37 °C humidified atmosphere.

4.2 MTT Assay of Ellipsoid-like Hollow YVO_4

This was determined by (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl-tetra-zolium bromide (MTT, Amresco 0793) assays to determine the cytotoxicity of various concentrations of the YVO_4 sample on Hela and 293T cells under normal physiological conditions (pH = 7.2-7.4). YVO_4 were dissolved in DMEM. Hela and 293T cells (1x10^4 cells $well^{-1}$) were plated in a flat-bottom 96-well plate (Costar) in culture medium (100 μL) and incubated in 5% CO_2 at 37 °C. After overnight incubation, the cells were treated with compound concentrations of 25, 50, 75, 100, 125, 150, 175, 200, and 500 μg mL^{-1}, respectively. After incubating the cells and YVO_4 compound for 24 h, the cells were washed with phosphate buffered saline (PBS) for three times. The MTT reagent (5 mg mL^{-1}) was then added to each well (10 μL $well^{-1}$, 0.5 mg mL^{-1}) and incubated for 4 h. Subsequently the medium was removed and the water insoluble formazan crystals formed, dissolved by the addition of DMSO (100 μL $well^{-1}$). The absorbance of purple formazan was measured using a Perkin Elmer VICTOR^3 1420 Multilabel Plate Reader at 490 nm. The relative cell viability (mean% ± SD, n = 3) was expressed as Abs compound/Abs control, where Abs control was obtained in the absence of the compounds.

4.3 Crystal Violet Staining

HeLa cell line was cultured in DMEM (Hylcone), containing 10% FBS (Hyclone), in 6-well plate (Costar) and treated with

0, 25, 50, and 125 μg mL^{-1} YVO_4 for 24 h. After the culture medium was pumped out by a vacuum pump, cells were washed twice with PBS and the PBS was discarded afterwards. Appropriate amount of 99% methanol was added to fixate the cells for 10 minutes, then the methanol was discarded. Appropriate amount of crystal violet solution was then added, keeping it for 10 min at room temperature. Recycle the crystal violet solution and wash the cells with PBS for 5 times to decolor the background. Then pump the PBS by a vacuum pump. The cells morphological features were examined by Nikon Ti-U Fluorescent Inverted Microscope and the photos were taken with a digital camera (COOPLIX P5100, Nikon).

5. Drug Loading and Release in Vitro

Typically, IBU was loaded to the hollow YVO_4 sample as follows: the YVO_4 sample (50 mg) was dispersed in hexane solution (10 mL) with an IBU concentration of 5 mg mL^{-1}. The mixture was allowed to stand at room temperature for 24 h, and the loading amount was determined according to the changed concentration of solution before and after stirred by spectrophotometric method (Beijing Puxi TU-1810-UV spectrophotometer) at 263 nm. The loaded materials were denoted IBU-loaded YVO_4 and rinsed three times with hexane and then dried under vacuum at 30 °C.

In vitro release profiles of IBU were evaluated by the dialysis method. First, a dialysis bag (cut-off molecular weight 3500 Da) was filled with a IBU-loaded YVO_4 buffer solution (5 mL, 10.0 mg mL^{-1}) and soaked of a buffer solution(0.05 M, 45 mL) of pH 7.4 at 37 ± 1 °C in a water bath with gentle shaking. The released IBU outside of the dialysis bag was sampled at a predetermined time and measured by UV-Vis absorption at 263 nm.

The other samples were given the same treatment to evaluate the effect of drug storage and release.

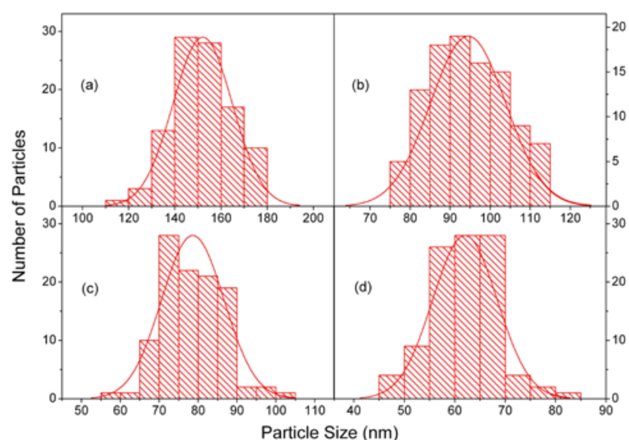

Fig. S1 Particle size distribution for YVO_4 obtained by hydrothermal process for $Y(OH)CO_3$ and NH_4VO_3 solutions of (a) 30 + 30 mL, (b) 40 + 40 mL, (c) 50 + 50 mL, and (d) 60 + 60 mL.

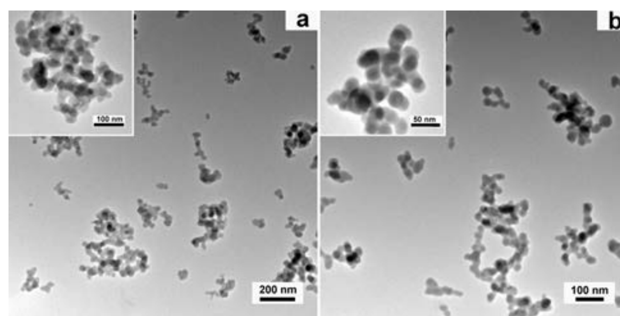

Fig. S2 TEM images of $Y(OH)CO_3$ obtained by hydrothermal process for $Y(NO_3)_3$ and urea solutions of (a) 30 + 30 mL, and (b) 50 + 50 mL.

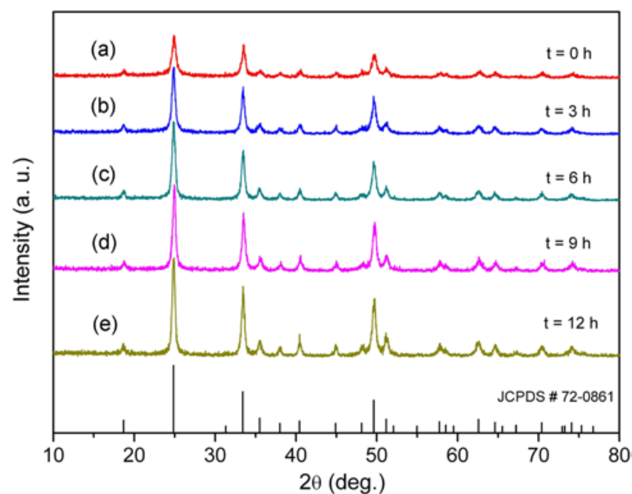

Fig. S3 XRD patterns of YVO_4 for various hydrothermal times ((a) t = 0 h, (b) t = 3 h, (c) t = 6, (d) t = 9, and (e) t = 12 h).

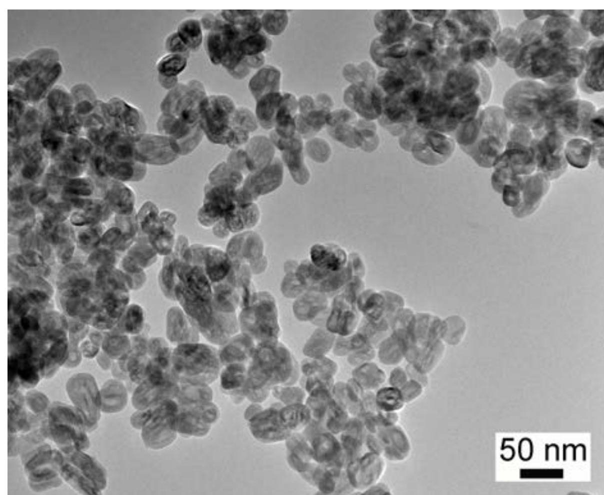

Fig. S4 TEM image of $GdVO_4$ prepared by hydrothermal process for $Y(NO_3)_3$ and urea solutions of 50 + 50 mL.