Electronic Supplementary Material (ESI) for Nanoscale.

Supplementary Information

for

A multifunctional protein pre-coated metal-organic framework for targeted delivery with deep tissue penetration

Oh et al.

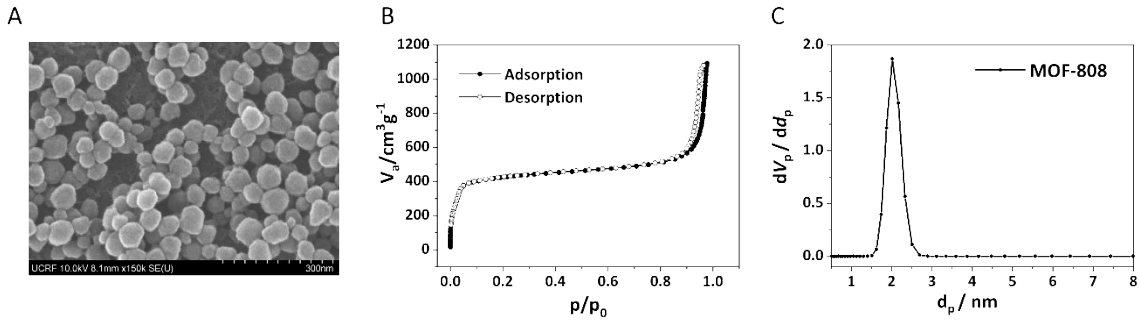

Fig. S1. Characterization of pure MOF-808 particles. (A) Scanning electron microscope (SEM) image of MOF-808 particles. (B) N_2 adsorption and desorption isotherms. (C) Pore size distribution obtained by using the N_2 adsorption isotherm.

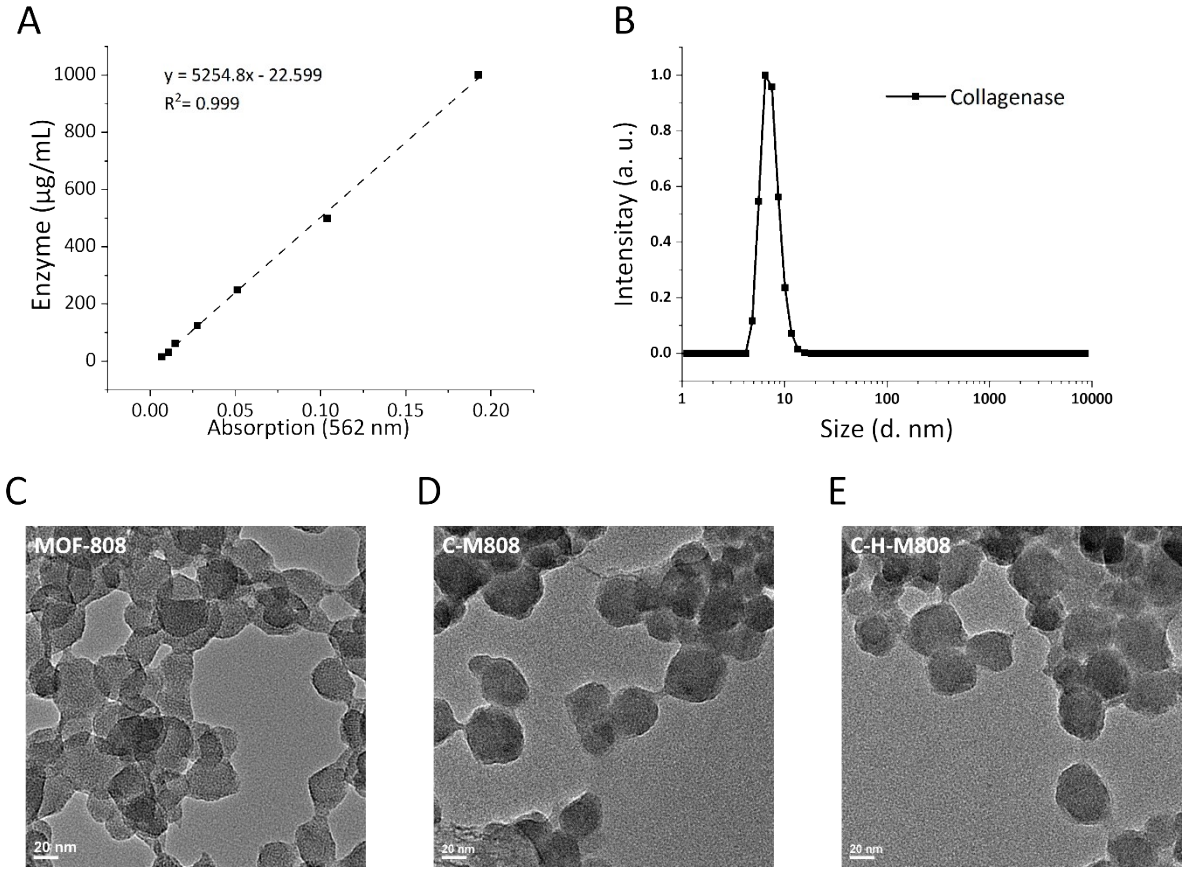

Fig. S2. (A) Collagenase standard curve for measuring collagenase attachment on Col-M808. (B) Dynamic light scattering analysis of collagenase (~6 nm). High magnification TEM images of (C) MOF-808, (D) Col-M808, and (E) Col-H-M808 particles

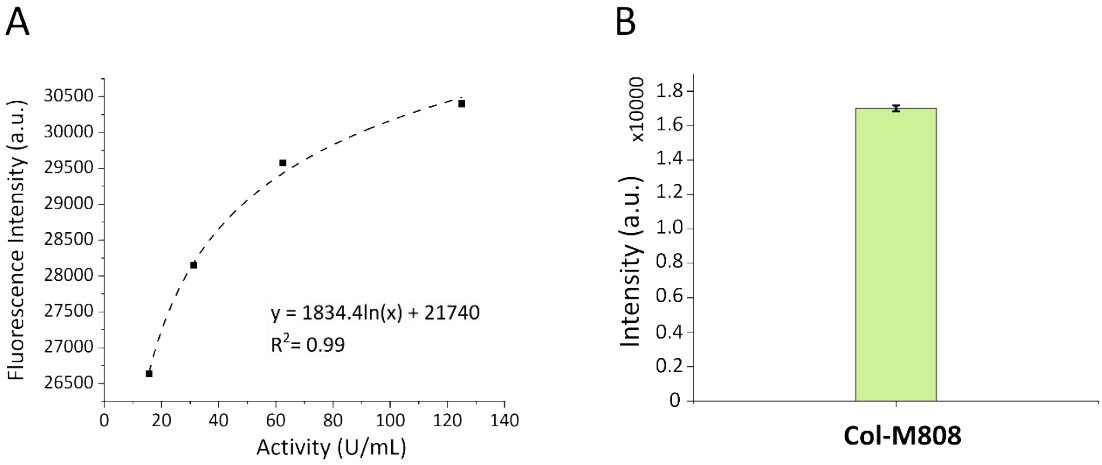

Fig. S3. (A) Collagen degradation assay: Measurement of collagenase activity of Col-M-808 using the standard curve (B) Enzymatic activity of Col-M808

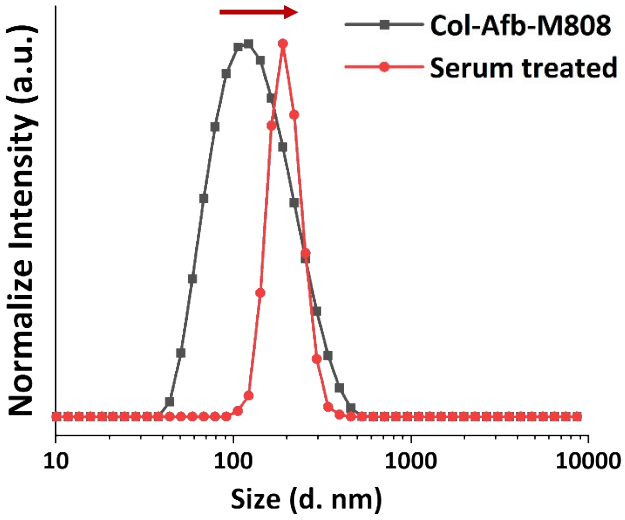

Fig. S4. Size distribution of Col-Afb-M808 before (Black), and after (red) treated to 10% serum solution for 1-hour incubation.

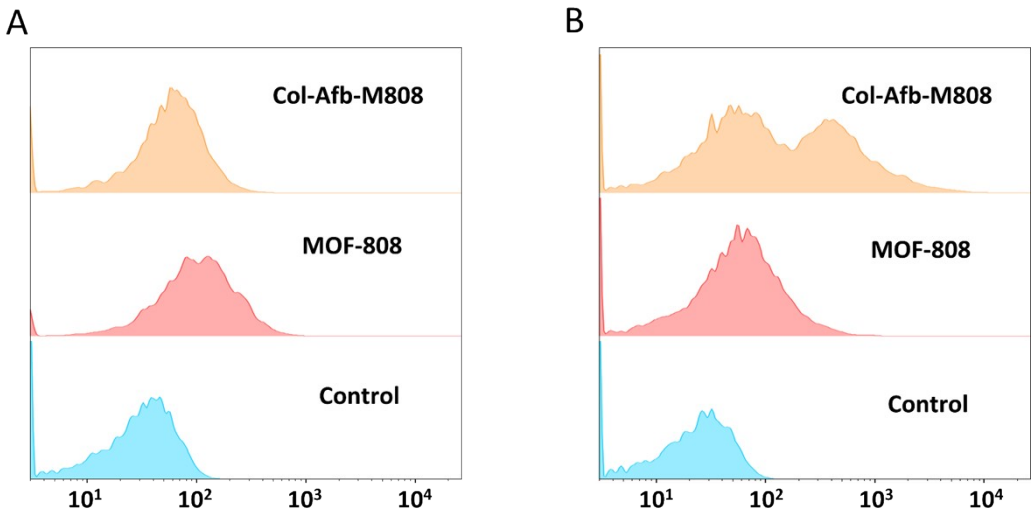

Fig. S5. Flow cytometry analysis of (A) RAW 264.7 cell and (B) 4T1 cells after treated with FITC loaded Col-Afb-M808 and MOF-808 for 6 hours.

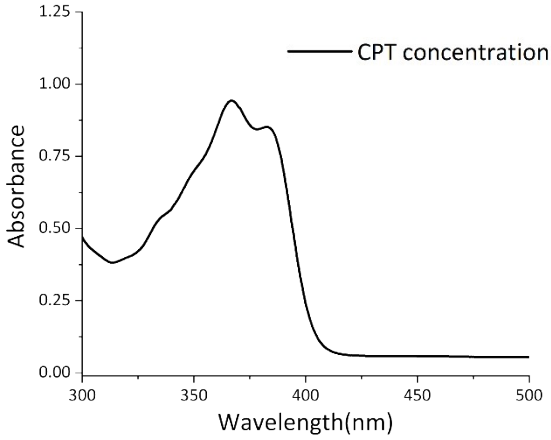

Fig. S6. The UV-VIS absorption spectrum of the supernatant of CPT solutions was analyzed. To do this, 5.0 mg of MOF-808 was dispersed in a drug solution containing 5 mg of drug molecules (CPT) in 1 mL DMSO. This mixture was stirred at room temperature for 24 hours. After stirring, the drug-loaded MOF-808 was centrifuged, and the supernatant was collected. The collected supernatant sample was used for measuring drug loading through UV-VIS absorption spectrum analysis, utilizing a molar absorption coefficient of 42,282 $(M \cdot cm)^{-1}$ at λ_{max} = 365 nm (CPT). The drug loading calculation was done using the following equation:

Drug loading capacity (%) = (Mass of drug in particle / Mass of particle) × 100

Entrapment efficiency (%) = (Mass of loaded drug / Initial mass of drug) × 100

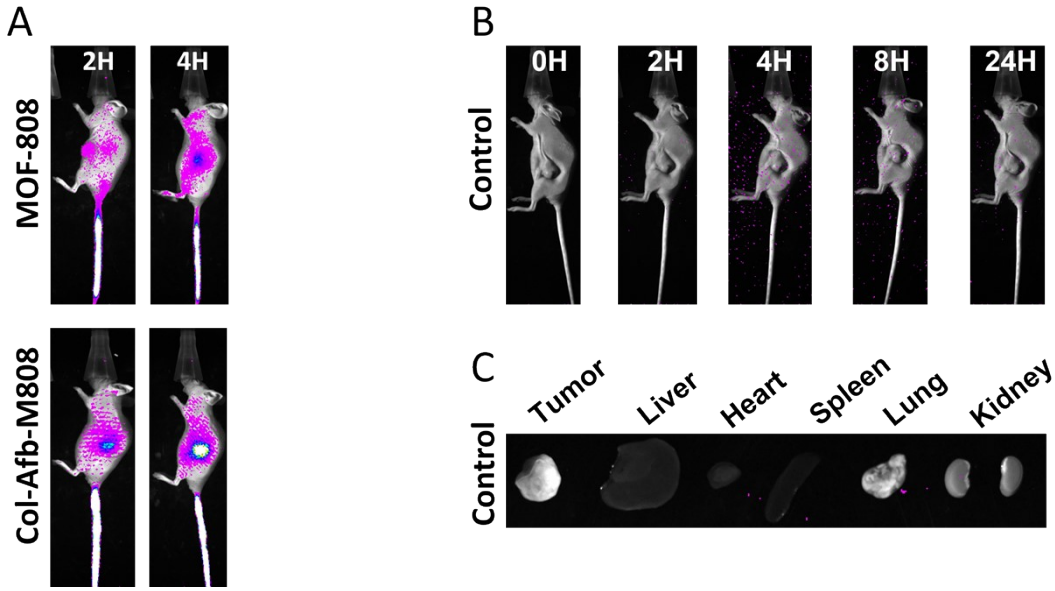

Fig. S7. Fluorescence emission from the 4T1-bearing mice (side) that were intravenously injected with IR-780 loaded (A) MOF-808, Col-Afb-M808 and (B-C) Control buffer solution (PBS 7.4).

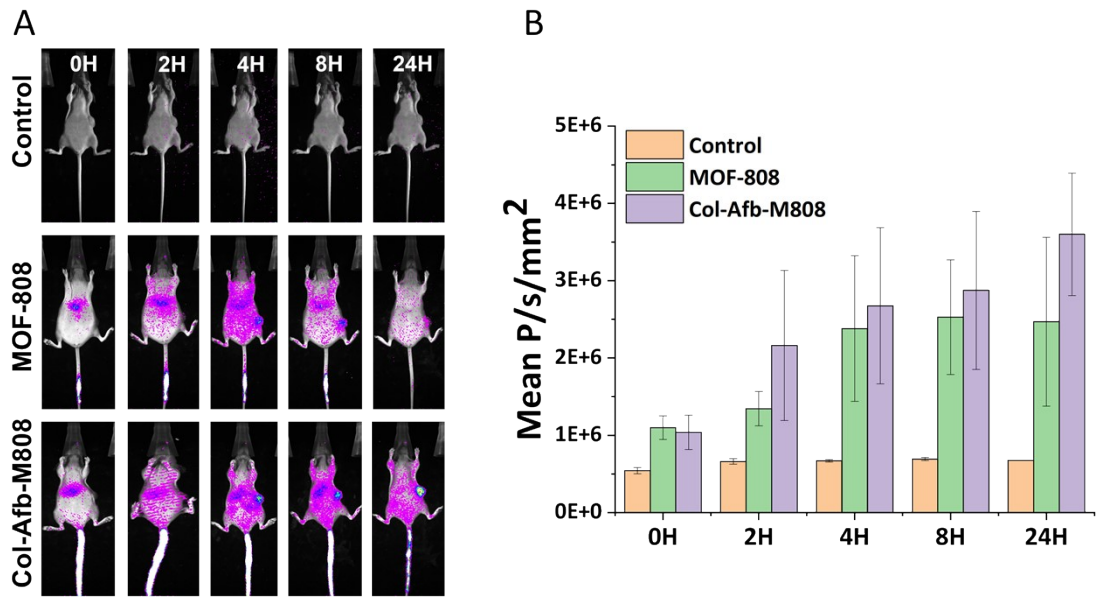

Fig. S8. Fluorescence emission from the 4T1-bearing mice (front) that were intravenously injected with IR-780 loaded (A) MOF-808, Col-Afb-M808 and Control buffer solution (PBS 7.4). (B) Intensity of Fig. S8A

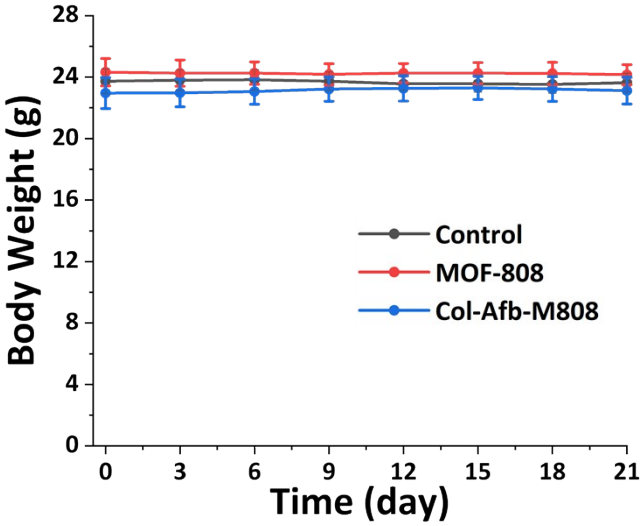

Fig. S9. Body weight (g) of the mice in each group treated.

Estimation of the Number of the proteins (GST-Afb, Collagenase) and ratio attached to one each MOF-808 Particle. This value was approximately calculated by using the TEM-observed average size of MOF-808(~ 50 nm; n = 80) and by assuming the 0.2 ~ 0.4 cm^3/g density of bulk MOF-808.

i) Number of GST-Afb proteins per 1 mg of the MOF-808 = 0.163 mg/ [M.W. of GST-Afb (3.6×10^7) mg/mol] × (6.02×10^{23})/mol = 2.71×10^{16}

ii) Number of particles in 1 mg = 1 mg/ [0.2 g/cm^3 × ($\frac{4}{3}\pi \cdot 25\ nm^3$)] = 3.81×10^{14}

Thus, the number GST-Afb proteins per particle = i)/ ii) = ~ 71

i) Number of GST-Afb proteins per 1 mg of the MOF-808 = 0.148 mg/ [M.W. of GST-Afb (7.2×10^7) mg/mol] × (6.02×10^{23})/mol = 1.24×10^{16}

ii) Number of particles in 1 mg = 1 mg/ [0.2 g/cm^3 × ($\frac{4}{3}\pi \cdot 25\ nm^3$)] = 3.81×10^{14}

Thus, the number Collagenase proteins per particle = i)/ ii) = ~ 32

i) Number of mixed proteins (GST-Afb and Collagenase) per 1 mg of the MOF-808 = 0.155 mg/ [M.W. of mean of proteins (5.4×10^7) mg/mol] × (6.02×10^{23})/mol = 1.67×10^{16}

ii) Number of particles in 1 mg = 1 mg/ [0.2 g/cm^3 × ($\frac{4}{3}\pi \cdot 25\ nm^3$)] = 3.81×10^{14}

Thus, the total number proteins per particle = i)/ ii) = ~ 44, and MW ratio of GST-Afb:Collagenase = ~1:2