

Electronic Supplementary Material (ESI) for *Pharmaceutics*

Smart Drug-Delivery System of Upconversion Nanoparticles Coated with Mesoporous Silica for Controlled Release

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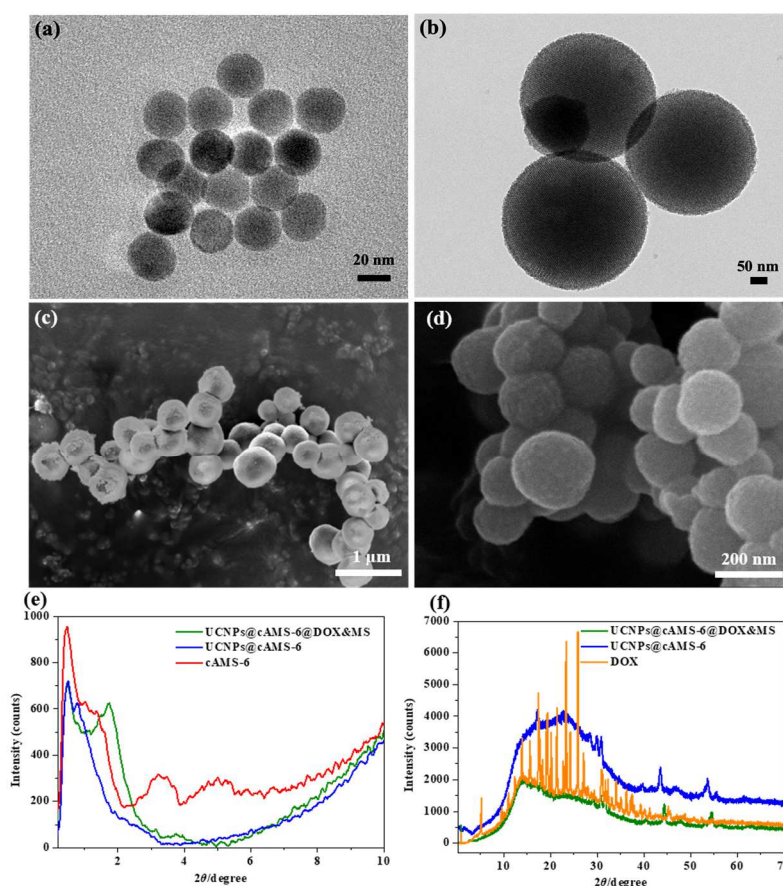


Figure S1. Properties of mesoporous particles of AMS-6, UCNPs@AMS-6 and UCNPs@AMS-6@DOX&MS. (a) Representative TEM image of the synthesized UCNPs. (b) representative TEM

images of cAMS-6. (c) SEM images of the cAMS-6 and (d) UCNPs@cAMS-6 nanoparticles, respectively. (e) Small-angle X-ray diffraction patterns of cAMS-6, UCNPs@cAMS-6 and UCNPs@cAMS-6@DOX&MS showing mesoscale diffraction peaks associated with the cubic mesostructure ($a_0 = 116.5 \text{ \AA}$ for the calcined AMS-6). (f) Powder X-ray diffraction patterns of UCNPs@cAMS-6@DOX&MS compared to the pure Dox compound showing the absence of scattering peaks from crystalline drug.

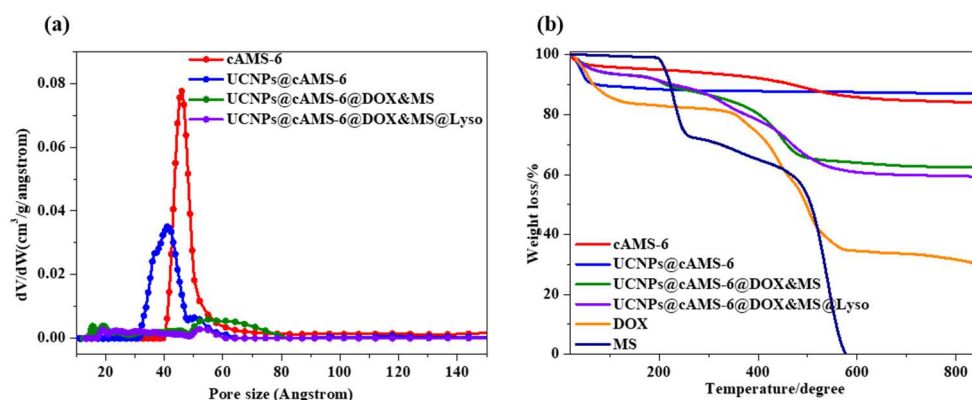


Figure S2. Drug loading and Protein Lysozyme coated UCNPs@cAMS-6. (a) Pore size distribution curve of cAMS-6, UCNPs@cAMS-6, UCNPs@cAMS-6@Dox/MS and UCNPs@cAMS-6@Dox/MS@Lyso samples. (b) Thermogravimetric analysis curves of cAMS-6, UCNPs@cAMS-6, UCNPs@cAMS-6@Dox/MS, UCNPs@cAMS-6@Dox/MS@Lyso, Dox and Molecule stirrer.

Table S1. Textural parameters of cAMS-6, UCNPs@cAMS-6, UCNPs@cAMS-6@Dox&MS and UCNPs@cAMS-6@Dox&MS@Lyso. The average pore volume, average pore size and surface area (P_{vol} , P_{size} and S_{area} , respectively) are obtained from N_2 adsorption measurements. The drug and Lysozyme content (%wt loss) was determined by thermogravimetric analysis. Data for Lysozyme coated particles was measured after washing unbound proteins (see supporting information experimental details).

Sample	$P_{vol} (\text{cm}^3 \cdot \text{g}^{-1})$	$P_{size} (\text{\AA})$	$S_{area} (\text{m}^2 \cdot \text{g}^{-1})$	%wt Lost
cAMS-6	0.77	46.50	694.96	8.3
UCNPs@cAMS-6	0.35	46.33	446.54	13.0
UCNPs@cAMS-6@Dox&MS	0.19	30.93	240.39	37.5
UCNPs@cAMS-6@Dox&MS@Lyso	0.11	25.57	156.12	41.31

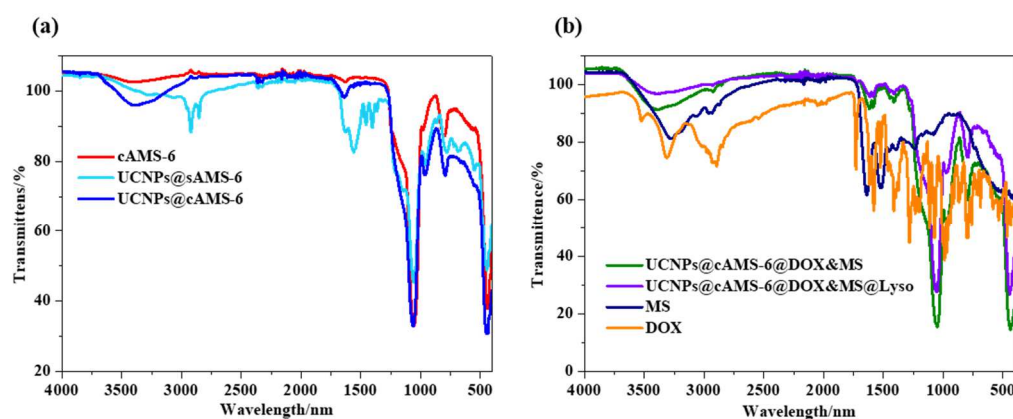


Figure S3. Fourier Transform Infrared (FT-IR) Spectra of (a) cAMS-6, UCNPs@sAMS-6, UCNPs@cAMS-6, and (b) UCNPs@cAMS-6@DOX&MS and UCNPs@cAMS-6@DOX&MS@Lyso samples. For comparison pure Dox and MS are also shown.

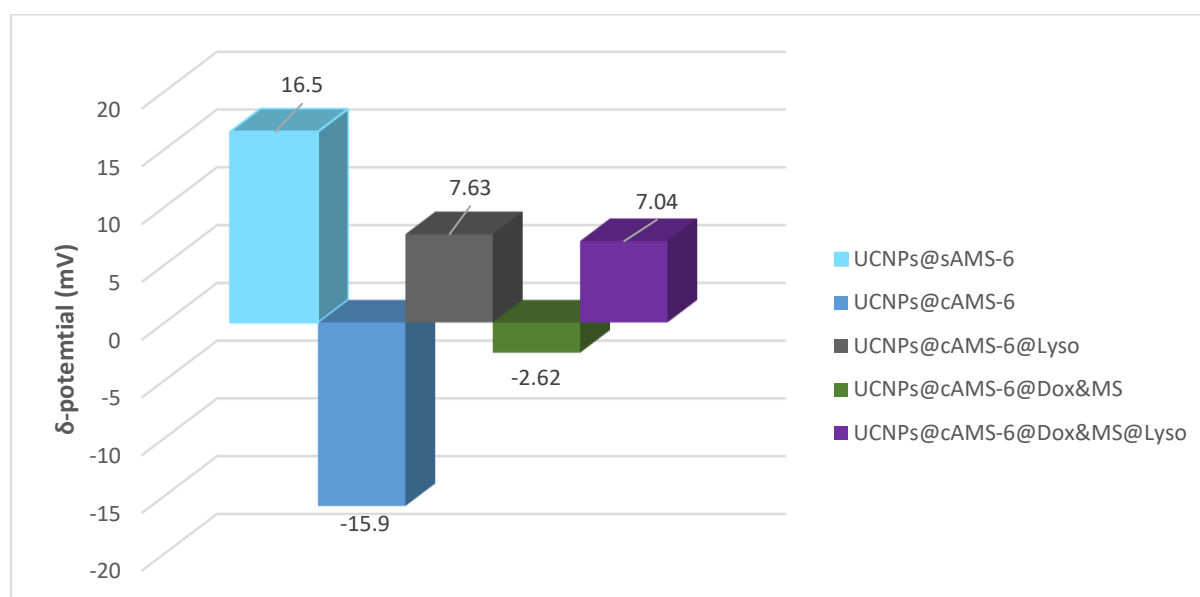


Figure S4. The zeta potential of UCNPs@sAMS-6, UCNPs@cAMS-6, UCNPs@cAMS-6@Lyso, UCNPs@cAMS-6@Dox&MS and UCNPs@cAMS-6@Dox&MS@Lyso samples.

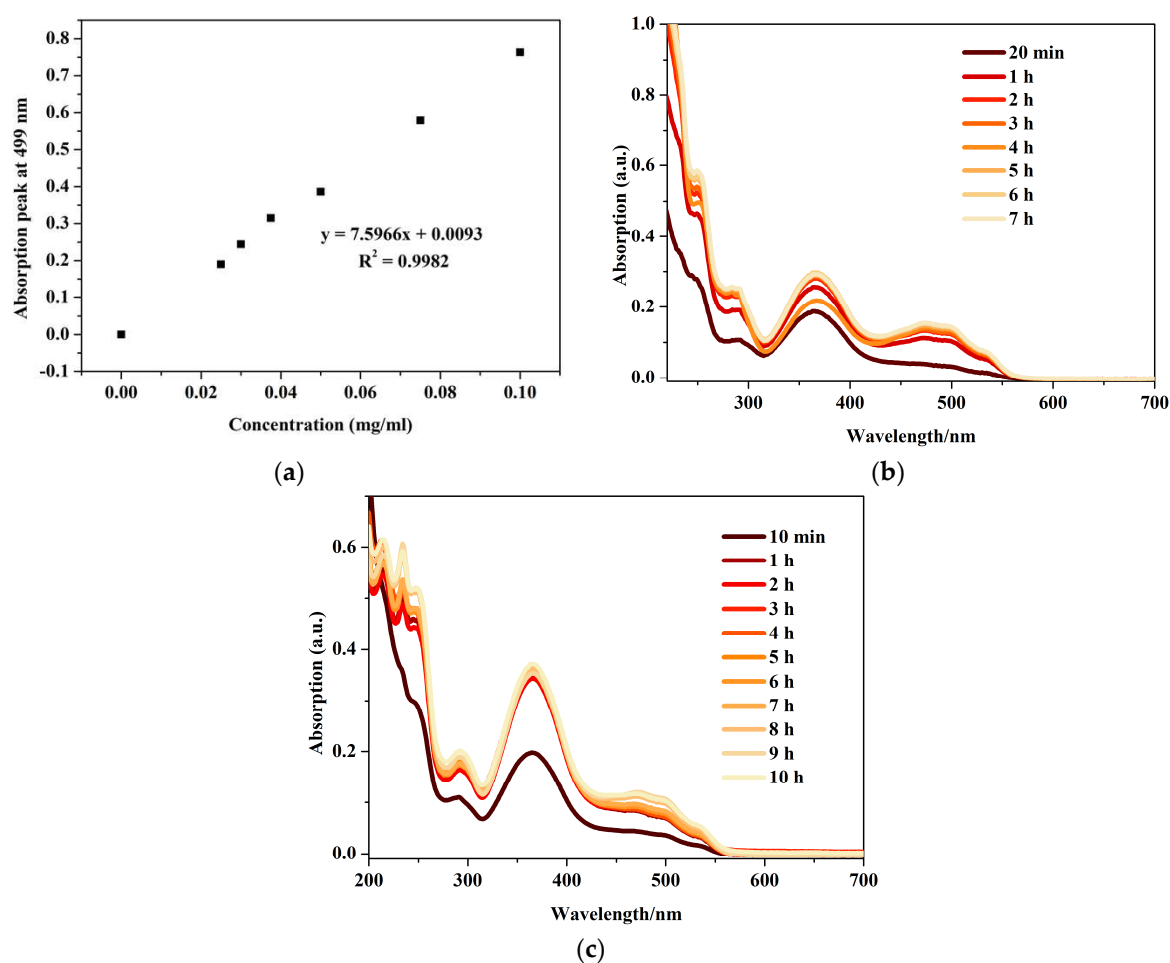


Figure S5. (a) Standard calibration curve of Dox at 499 nm; UV-Vis absorption profile of Dox absorption test in (b) UCNPs@cAMS-6@Dox&MS and (c) UCNPs@cAMS-6@Dox&MS@Lyso samples.

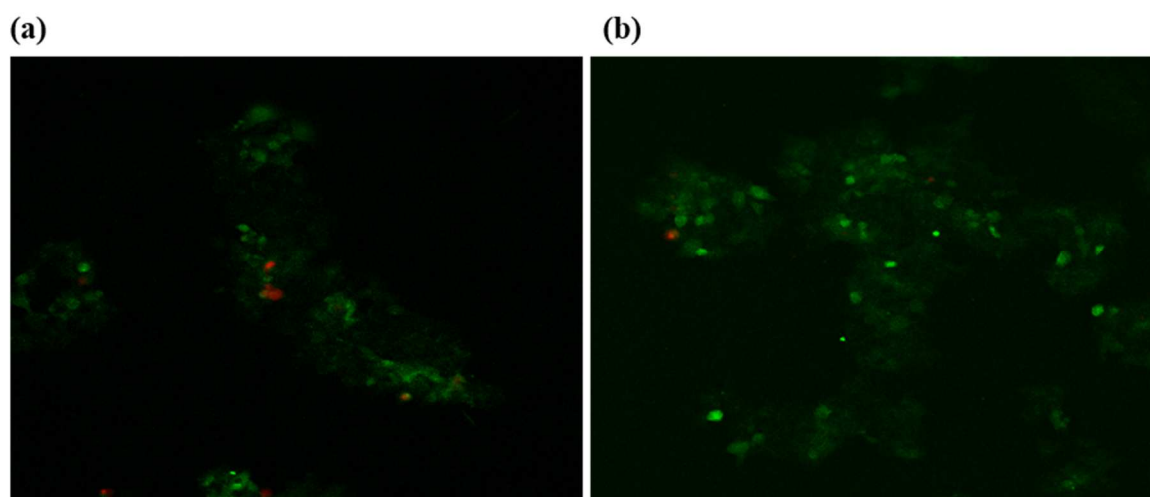


Figure S6. Confocal microscopic images of live (green) and dead (red) cells exposed to (a) UCNPs@cAMS-6 and (b) UCNPs@cAMS-6@Lyso. All images were taken under 10× objective lens.

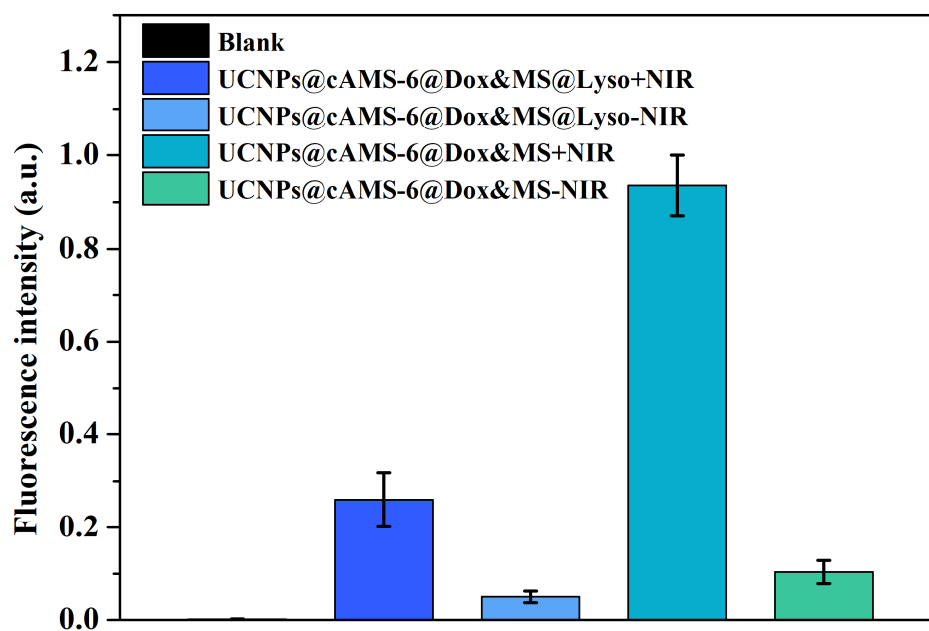


Figure S7. Fluorescence intensity in response to controlled release of Dox in all prepared samples.