ELECTRONIC SUPPORTING INFORMATION

Method for Controlling Intracellular Protein Activity Using Photoresponsive Nanoparticles

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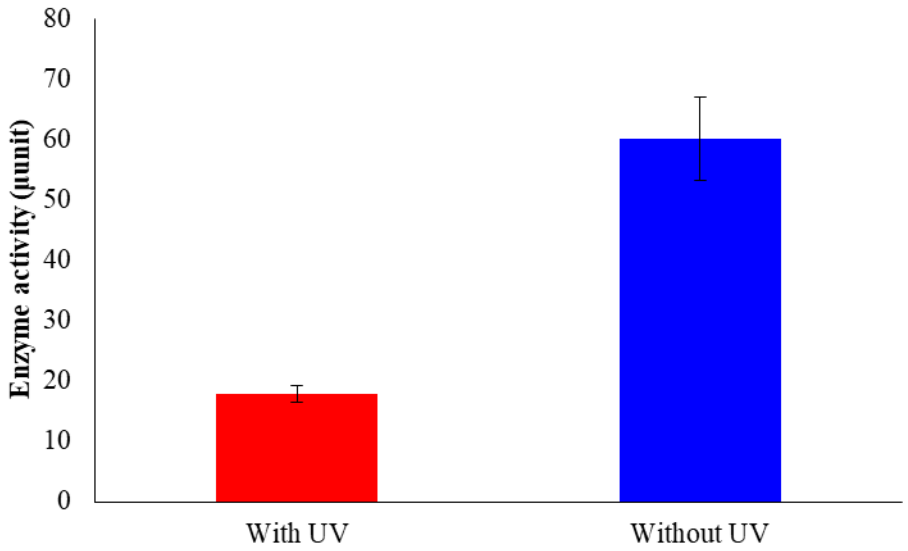
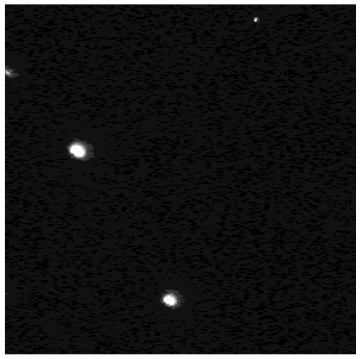
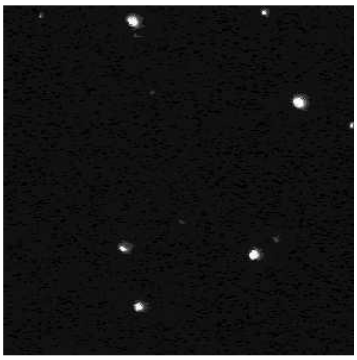


Fig. S1. (Color online) Free caspase activities with and without UV irradiation. The activity of free caspase exposed to UV light was measured under the same UV intensity as that used to release nanoparticles inside the cells (results in Fig. 5). The activity of caspase not exposed to UV light was confirmed under the same conditions as those shown in Fig. 4. These data suggest that the activity was sufficiently maintained, despite the reduction after UV light irradiation.

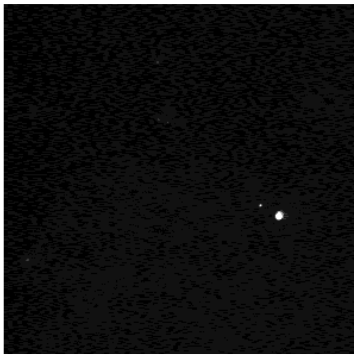
ISSN 0914-4935



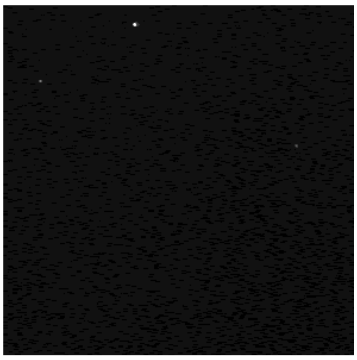
(a-i)
132 nm
3.2×10^9 nanoparticles/mL



(a-ii)
10.1 mV
4.6×10^9 nanoparticles/mL

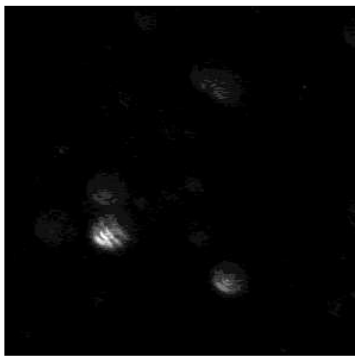


(b-i)
143 nm
1.5×10^9 nanoparticles/mL

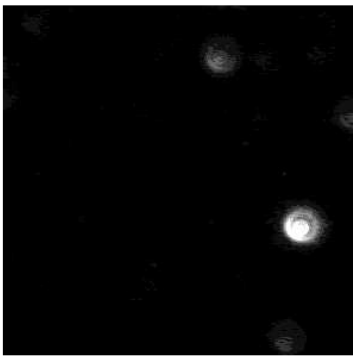


(b-ii)
4.3 mV
3.0×10^9 nanoparticles/mL

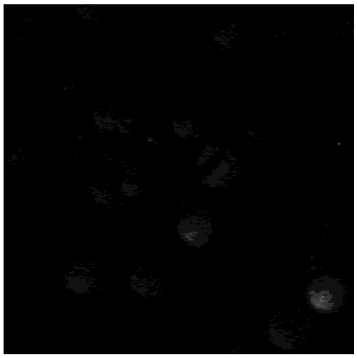
Fig. S2. Physical properties (particle tracking analysis (PTA) images and concentration) of nanoparticles with encapsulated FITC-Dex. (a) 3-kDa FITC-Dex and (b) 10-kDa FITC-Dex. (i) Nanoparticle size and (ii) nanoparticle surface charge.



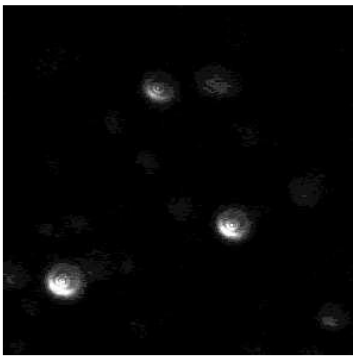
(a-i)
151 nm
3.0×10^9 nanoparticles/mL



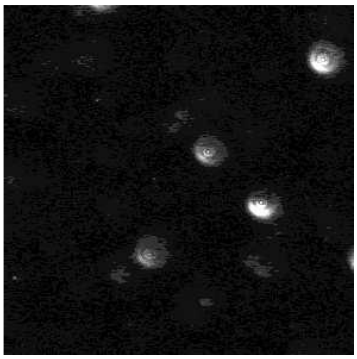
(a-ii)
4.3 mV
5.6×10^9 nanoparticles/mL



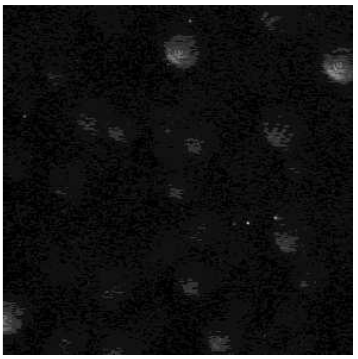
(b-i)
143 nm
3.6×10^9 nanoparticles/mL



(b-ii)
1.4 mV
3.8×10^9 nanoparticles/mL



(c-i)
144 nm
1.9×10^{10} nanoparticles/mL



(c-ii)
8.3 mV
2.8×10^{10} nanoparticles/mL

Fig. S3. Physical properties (particle tracking analysis (PTA) images and concentration) of nanoparticles with encapsulated caspase 3 at different concentrations: (a) 0.25 µunit, (b) 2.5 µunit, and (c) 25 µunit. (i) Nanoparticle size and (ii) nanoparticle surface charge.

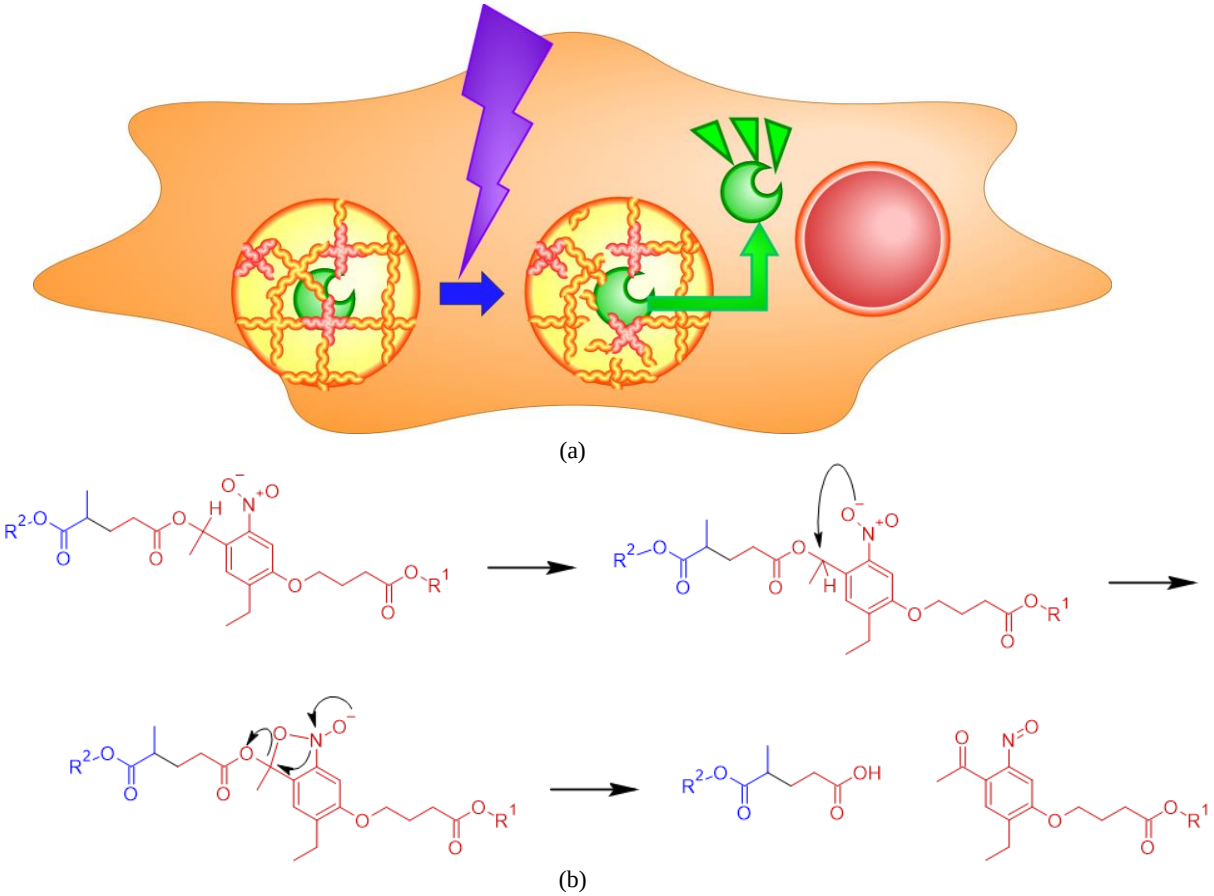
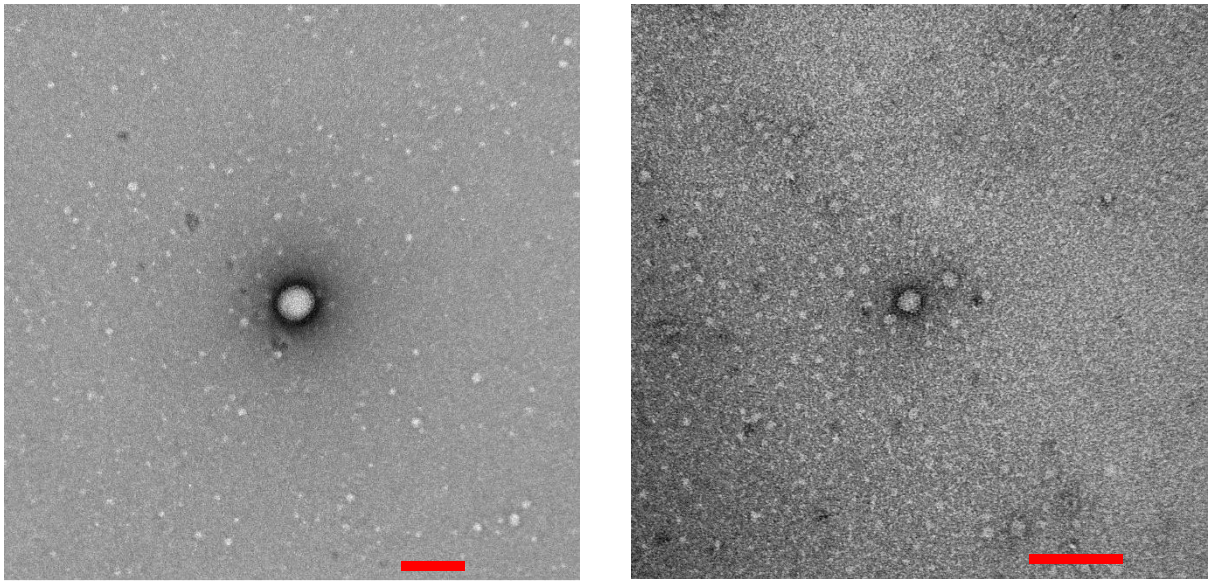
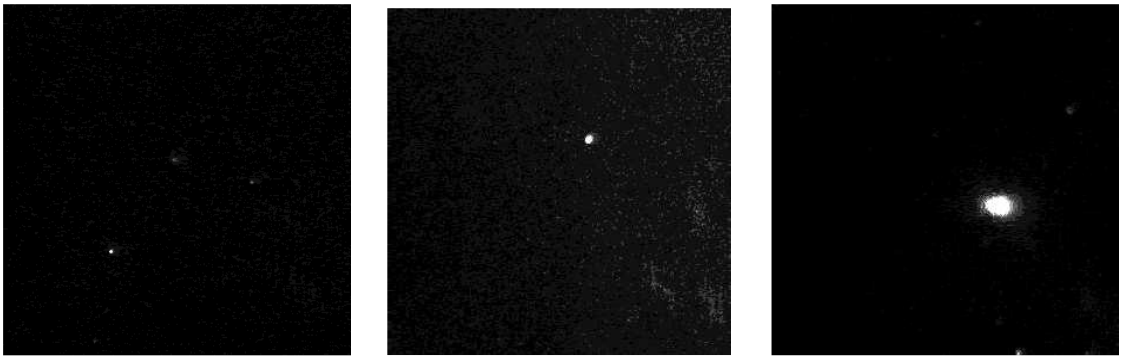


Fig. S4. (Color online) (a) Illustration of photocleavable nanoparticle showing encapsulation and release of various proteins in cell. (b) Effect of FITC-Dex molecular weight on amounts of encapsulated and released molecules. FITC-Dex (1 mg) was encapsulated in each nanoparticle. After washing, the amount of FITC-Dex encapsulated in each nanoparticle was determined from its fluorescence intensity (λ_{ex} = 494 nm, λ_{em} = 518 nm). The nanoparticles were then UV-irradiated to release the FITC-Dex (n = 3).



(a) (b)

Fig. S5. Transmission electron microscopy images of nanoparticles with encapsulated caspase 3 (2.5 μunit). (a) Non-UV-irradiated and (b) UV-irradiated nanoparticles are 70–90 nm and 30–50 nm in size, respectively. These data suggest that the nanoparticles shrank under vacuum and retained their shapes without complete decay after UV irradiation. Scale bars: 100 nm.



(a) 159.2 nm, 3.53 ± 0.76 mV

(b) 140.3 nm, 3.61 ± 0.12 mV

(c) 149.9 nm, 4.39 ± 0.20 mV

Fig. S6. Stabilities of nanoparticles confirmed by PTA images. (a) 0 d without UV, (b) 0 d with UV, and (c) 1 d without UV. The sizes and zeta potentials suggest that the nanoparticles do not entirely disintegrate upon UV irradiation.

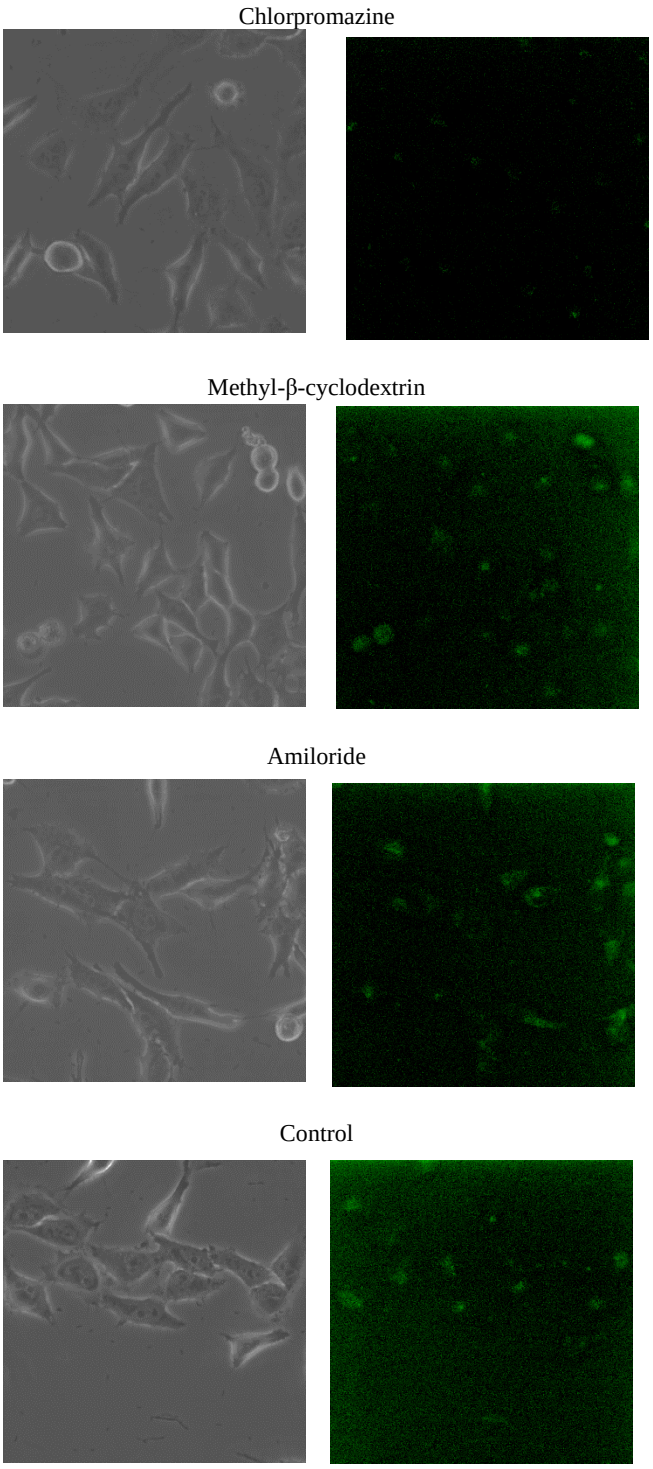


Fig. S7. (Color online) Separate fluorescence (λ_{ex} = 494 nm and λ_{em} = 518 nm) and bright-field images of cells with nanoparticles and three endocytosis inhibitors. The images are combined in Fig. 3.

Table S1
Physical properties of other nanoparticles with enzymes determined by ZetaView.

	Amount (μunit)	Nanoparticle size (nm)	ζ (mV)
Elastase	80	110	8.7
	800	116	0.9
	8000	123	2.7
Chymotrypsin	800	101	2.7
	8000	132	0.03