Electronic Supplementary Information

Geometrical confined ultrasmall gadolinium oxide nanoparticles boost the $T_1$ contrast ability

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Figure S1. Nitrogen adsorption-desorption isotherms of MSN. The value of specific surface area is 396.5 m²/g.
Figure S2. Dynamic light scattering (DLS) analysis of water-dispersible MSN and Gd$_2$O$_3$@MSN nanocomposites.
Figure S3. Structural characterization on Gd$_2$O$_3$@MSN. (a) TEM image and (b) energy dispersive X-ray (EDX) analysis of Gd$_2$O$_3$@MSN in (a) in the copper mesh. The red circles show the existence of silicon and gadolinium.
Figure S4. *In vitro* cytotoxicity analysis. The MTT assay of HepG2 cells incubated with (a) Gd$_2$O$_3$, (b) MSN, (c) Gd$_2$O$_3$@MSN for 24 h ($n = 5$/group).
Figure S5. MR relaxivity at 0.5 T. The analysis of relaxation rate (a) $R_1 (1/T_1)$ (b) $R_2 (1/T_2)$ vs. gadolinium ion concentration for Gd$_2$O$_3$ and as-prepared Gd$_2$O$_3$@MSN using a 0.5 T NMR20-Analyst NMR system. Gd$_2$O$_3$@MSN-1 and Gd$_2$O$_3$@MSN-2 are two samples with Si: Gd=100:1 and 25: 1, respectively. These results indicated that the MRI contrast effect can be enhanced with the increase of Si/Gd ratio, in other words, the amount of ultrasmall Gd$_2$O$_3$ loaded in MSN.
Figure S6. Examples of regions of interest (ROIs) selected on the *in vivo* MR image: circles 1-4 represent liver regions, circles 5-8 for background.