Supplementary Note

R2 relaxivity coefficient per single nanoparticle (R2\((p)\)) of spinel structured MnMEIO and CLIO

Since the size of MnMEIO is \(\approx 12\) nm, the approximate mol of magnetic atom \((N/N_A)\) in single MnMEIO nanoparticle is

\[
\frac{N}{N_A} = n \left(\frac{\text{volume of nanoparticle}}{\text{volume of unit cell}}\right) / N_A = n \left(\frac{r}{a}\right)^3 / N_A
\]

\[= 24 \times \left(\frac{6 \text{ nm}}{0.85 \text{ nm}}\right)^3 / (6.021 \times 10^{23} \text{ mol}^{-1})
\]

\[= 1.402 \times 10^{-20} \text{ mol}
\]

where \(N\) is the number of magnetic atoms in single MnMEIO nanoparticle, \(N_A\) is the Avogadro’s number, \(n\) is the number of magnetic atom in unit cell, \(r\) is nanoparticle radius and \(a\) is the lattice parameter of spinel MnFe\(_2\)O\(_4\).

R2 relaxivity coefficient per single MnMEIO nanoparticle \((R2\((p)(\text{MnMEIO})\)) can be now expressed by

\[
R2\((p)(\text{MnMEIO}) = \frac{(\text{R2 relaxivity coefficient per 1 mol of magnetic atoms}) \times N / N_A}{(\text{single MnMEIO nanoparticles})}
\]

\[= 358 \text{ l-mmol}^{-1} \text{s}^{-1} \times 1.402 \times 10^{-20} \text{ mol} \times (\text{single MnMEIO nanoparticle})^{-1}
\]

\[= 5.02 \times 10^{-15} \text{ s}^{-1} \text{ (single MnMEIO nanoparticle)}
\]

Similarly, R2 relaxivity coefficient per single CLIO nanoparticle can be calculated. Considering that size of CLIO is \(\approx 4\) nm (See Berry, C. C.& Curtis, S. G. J. Phys. D: Appl. Phys. 36, R198-R206 (2003).) and R2 relaxivity coefficient per (1 mole of magnetic atom) is 62 l-mmol\(^{-1}\cdot\text{s}^{-1}\), calculated R2 relaxivity coefficient per single CLIO nanoparticle is

\[
R2(p)(\text{CLIO}) = \frac{3.22 \times 10^{-17}}{(\text{single CLIO nanoparticles})^{-1}}
\]
Targeting mechanism of our MnMEIO-Herceptin conjugates

We also examined the targeting mechanism of our nanoparticle-antibody conjugates to the tumor tissues, since MR contrast effects can arise not only from the specific binding of our MnMEIO-Herceptin conjugates to HER2/neu of tumor tissues (i.e. active targeting), but also from the enhanced permeation and retention (EPR) effect of the conjugates (i.e. passive targeting) (See: Jain, R. K. Delivery of molecular medicine to solid tumors: lessons from in vivo imaging of gene expression and function. J. Control. Release 74, 7-25 (2001)). According to our passive targeting experiments (Supplementary Fig. 4), the cancer detection is driven by the specific binding of our targeted MnMEIO-Herceptin conjugates rather than via passive targeting.