Supplementary material

Multifunctional Nanoparticles for Rapid Bacterial Capture, Detection, and Decontamination

Longyan Chen [a], Fereidoon S. Razavi [b], Abdul Mumin [a], Xiaoxuan Guo [c], Tsun-Kong Sham [c], and Jin Zhang[a]*

1. XRD measure

Powder X-ray diffraction (XRD) measurement was performed at room temperature with a Rigaku Toraflex RTP 300 (45 kV, 160 mA) using Co Kα (λ = 1.790260 Å) radiation. The scan range (2θ) was from 13° to 70° with a step width of 0.02^{o} 2θ as shown in Fig S-1

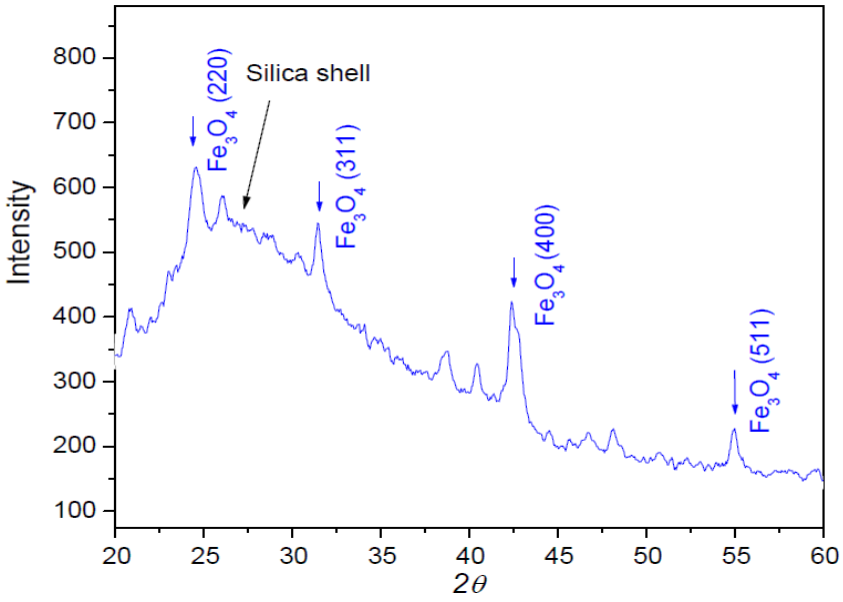

Figure S-1. XRD profile of FMNPs.

2. Magnetic saturation of FMNPs

The produced FMNPs were measured by superconducting quantum interference devices (SQUIDs) under a field of 60K Oe at room temperature. The saturated magnetization is approaching to 40 emu/g as shown in the Fig. S-2.

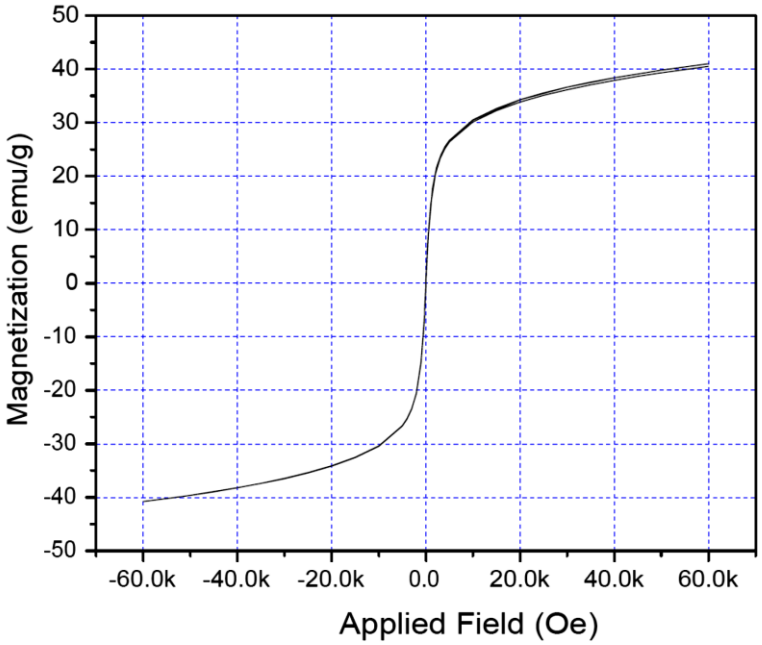

Figure S-2. Hysteresis loop of FMNPs measured at room temperature with magnetic field of 60K Oe.

For the core-shell structure of FMNPs, the average diameter of iron oxide core is estimated at 50±8 nm, while the thickness of silica shell is about 10±5 nm. The mean particle size is approximately 65±8 nm. Therefore, it is 46% in volume ratio can contribute to the magnetic properties of FMNPs. It is noted that the densities of SiO_2 NPs, Fe_3O_4NPs, and Fe_2O_3 NPs are 2.65 g/cm^3, 4.95 g/cm^3 , and 5.2 g/cm^3, respectively. Assuming the magnetic core was Fe_2O_3, it is estimated that ~62.5 wt% of the FMNPs contribute to the magnetic properties. Assuming the magnetic core are pure Fe_3O_4, it is estimated that ~61.2 wt% of the FMNPs contributes to the magnetic properties. Our calculation indicates that the saturated magnetization is about 65.4 emu/g. It is noted that the M_s of pure magnetite Fe_3O_4 is about 65 emu/g, which is 2.5 times of Fe_2O_3 NPs [1]. Consequently, the core of FMNPs is made of Fe_3O_4, which is also confirmed by the results of X-ray absorption near edge structure spectroscopy (XANES) as discussed in our manuscript.

3. Determine the concentration of gentamicin on the FMNPs

To determine the amount of Gm conjugated on FMNPs, o-phthalalehyde (OPA) is labeled with Gm as discussed in previous reports [2-3]. The amount of Gm conjugated on FMNPs was labeled

with o-phthalalehyde (opa) which has the fluorescent emission at 450 nm, and absorption at 292 nm. The optical signals *vs.* the concentration (μg/mL) of OPA is as shown in Fig. S-2.

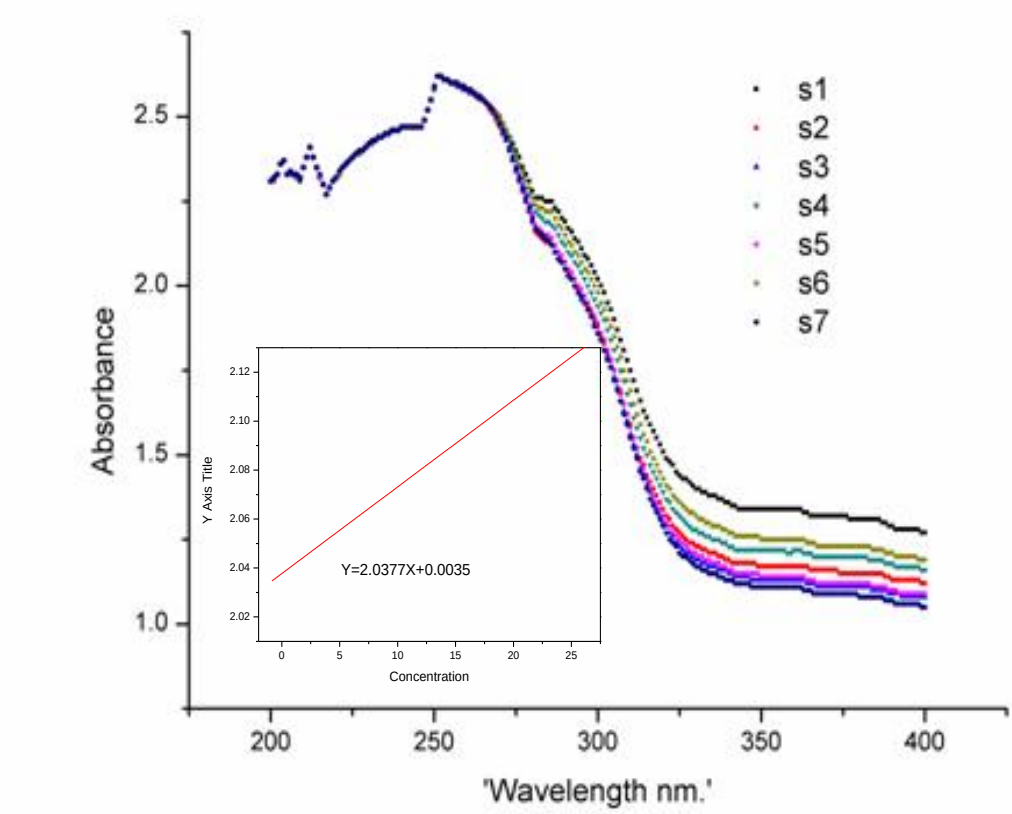

Figure S-3. UV-vis spectra of o-phthalalehyde (OPA) with different concentration.

Table S-1. Absorption values at 292 nm of OPA-labeled Gm-FMNPs.

UV Absorption	OPA labeled Gm-FMNPs (fresh sample, 0.5 mg/mL)	OPA labeled Gm-FMNPs (sored for two months, 0.5 mg/mL)
I (em)	2.44	2.15

The products were washed several times followed by the 1 min ultrasound bath at room temperature to make sure that there is no free OPA in the final products. Our results indicate that 40 μg of Gm can be conjugated onto 0.5mg FMNPs, that is, there is about 8 μg of Gm

conjugated onto 0.1 mg FMNPs. The decrease of absorption intensity after storing for 2 months is caused by the decay of the OPA with time.

References

[1] Clauter DA and Schmidt VA. Shifts in blocking temperature spectra for magnetite powders as a function of grain size and applied magnetic field. Phys. Earth & Planetary 1981;26: 81-92.

[2] Al-Amoud AI, Clark BJ, and Chrystyn H, Determination of gentamicin in urine samples after inhalation by reversed-phase high-performance liquid chromatography using pre-column derivatisation with o-phthalaldehyde. J Chromatogr B 2002;769: 89–95.

[3] Ramos Fernández JM, García Campaña AM, Alés Barrero F, and Bosque Sendra JM. Determination of gentamicin in pharmaceutical formulations using peroxyoxalate chemiluminescent detection in flow-injection analysis. Talanta 2006;69: 763–768.