Electronic Supplementary Material (ESI) for Nanoscale

Supporting Information

Targeted nanoparticles for enhanced X-ray radiation killing of multidrug-resistant bacteria

Yang Luo,[a,b] Mainul Hossain,[b] Chaoming Wang,[b] Yong Qiao,[b] Jincui An,[b] Liyuan Ma[b] and Ming Su*[b]

[a] Department of Laboratory Medicine, Southwest Hospital, Third Military Medical, University, Chongqing 400038, China

[b] NanoScience Technology Center, University of Central Florida, Orlando, Florida, 32826, USA. E-mail: ming.su@ucf.edu

Grafting density of antibody on the surface of bismuth nanoparticles:

The grafting density of antibody on nanoparticles is estimated by measuring the difference of UV absorbance at 280nm before and after removing nanoparticles from suspension of antibody. An average binding efficiency of 18.5 μg/mg (mass of antibody/mass of bismuth nanoparticles) is obtained. Then the grafting density (*N*) can be estimated using the equation:

$$N = \frac{number\ of\ moles\ of antibody}{number\ of\ moles\ of\ bismuth\ nanoparticle}$$

1. The molar number of 1 μg antibody can be calculated as follows:

Taken the average MW of IgG antibody as 150 kD, 1 μg of a 15 kDa IgG antibody is calculated as 6.67×10^{-12} mol as follows:

$$1\ \mu g\ antibody = \frac{1\mu g}{150000 g/mol} = 6.67 \times 10^{-12}\ mol$$

2. The molar number of 1 mg antibody can be calculated to be 4.05×10^{-11} as follows:

Firstly, the mass of each bismuth nanoparticle is calculated as 4.1×10^{-17}g using the following equation, assuming the bismuth nanoparticle is a spheroid and they are in a normal size distribution (diameter of 30 nm), and the density of bismuth is 9.78 g/cm^3.

$$M_{per\ nanoparticle} = \rho v = \frac{4}{3}\pi r^3 \rho$$

Then, the number of bismuth nanoparticle is calculated to be 7.23×10^{12} (for 1 mg bismuth nanoparticle).
Third, the molar number of 1 mg bismuth nanoparticle can be calculated to be 1.2×10^{-11} using the formation:

$$Number\ of\ moles = \frac{number\ of\ particles}{Avogadro's\ number} = \frac{7.23 \times 10^{12}}{6.02 \times 10^{23}} = 1.2 \times 10^{-11}$$

3. The grafting density can be estimated using the first equation:
   Considering the measured binding efficiency of 18.5 μg/mg (mass of antibody/mass of bismuth nanoparticles), the *N* is calculated to be 10.3 as follows:

$$N = \frac{number\ of\ moles\ of antibody}{number\ of\ moles\ of\ bismuth\ nanoparticle} = \frac{18.5\times 6.67\times10^{-12} mol}{1.2\times10^{-11}\ mol} = 10.3$$

SUPPORTING FIGURES

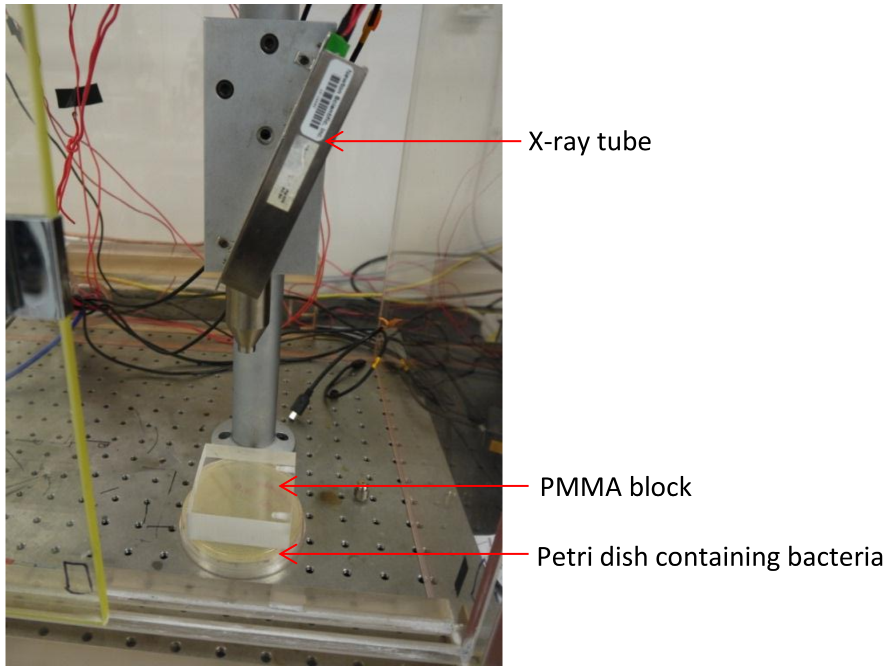

Figure S1. Experimental setup.

In order to derive dose-dependent bactericidal activity of nanoparticles, the X-ray source is fixed at 10cm from an PMMA block (7×7×2 cm^3) mimicking the human tissue. MDR *P. aeruginosa* suspension (~10^5) in LB medium is taken in a petri dish that is fixed underneath PMMA, simulating a deep wound with MDR bacterial infection.

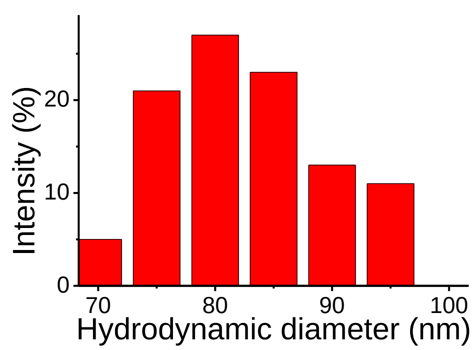

Figure S2. DLS results of *P. aeruginosa* antibody conjugated bismuth nanoparticles in PBS.

Result shows *P. aeruginosa* antibody conjugated bismuth nanoparticles in PBS (pH 7.4) with a size range from 70-95 nm and a mean diameter of 82 nm. These results show that antibody modified nanoparticles are nearly mono-dispersed in PBS with a normal distribution.