Detection of pathogenic bacteria using half-fragments antibody immobilized Fe_3O_4@$FeSe_2$ core-shell nanoparticles

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Iron diselenide($FeSe_2$)-coated Fe_3O_4 magnetic nanoclusters (MNCs) were synthesized to detect pathogenic bacteria. MNCs were hydrothermally synthesized and coated with $FeSe_2$ via co-reduction method. Hydrazine hydrate reduced Fe_3O_4 and Se powder to Fe^{2+} and Se_2^{2-}, respectively. Co-reduction enabled $FeSe_2$ shell to grow directly on the surface of MNCs. The stability and magnetization of Fe_3O_4@$FeSe_2$ nanoparticles were controlled by addition of a small amount of $FeCl_3$. $FeSe_2$ shell enhanced the bacterial capture efficiency due to the favorable orientation of half fragments of anti-Escherichia coli antibodies through selenosulfide bond and the large surface area of the particles. As a results, the capture efficiency of Fe_3O_4@$FeSe_2$ nanoparticles via selenosulfide-based immobilization of antibodies was two times higher than that of Fe_3O_4 nanoparticles through amide-based immobilization of antibodies.