**Supporting Information**

**Magnetoplasmonic core-shell structured Ag@Fe3O4 particles synthesized via polyol reduction process rendering dual-functionality for bacteria ablation and dyes degradation**

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**Figure S1**. (a, b) SEM and (c) TEM images of the c-Ag.

**Table S1**. The Atomic Absorption Spectroscopy results for the contents of Ag and Fe in the Ag@Fe3O4 (by dissolving 0.1963 g sample in 250 mL solution).

|  |  |  |
| --- | --- | --- |
| Test item | Ag | Fe |
| Sample concentration  after dilution (mg L−1) | 1.374 | 7.298 |
| Dilution ratio | 50 | 50 |
| Sample concentration  before dilution (mg L−1) | 68.7 | 364.9 |
| Weight percentage (%) | 20.8 | 57.3 |
| Molar ratio percentage (%) | 8.75 | 46.47 |

\* The weight percentage of Fe3O4 is calculated based on the weight percentage of Fe (57.3%/((3\*55.845)/(3\*55.845+4\*15.9994)) = 79.2%). Ag (20.8 wt%) + Fe3O4 (79.2 wt%) = Ag@Fe3O4 (100.0 wt%).



**Figure S2**. (a) The XPS full spectrum and (b) O 1s spectrum of the Ag@Fe3O4.

**Table S****2**. Comparison of the antibacterial properties by different Ag-based nanoparticles towards *E. coli.*

|  |  |  |  |
| --- | --- | --- | --- |
| Samples | Preparation method | Antibacterial property (AE, MIC) | Ref. |
| Fe3O4@Ag@TiO2 | The raspberry-like structure of bimetallic Fe@Ag nanoparticles was initially prepared by chemically reducing ferrous sulfate in water with the presence of sodium borohydride as a reducing agent. This was followed by redox transmetalation through the addition of silver nitrate solution at room temperature. Finally, reagent-grade 2-mercaptoethanol molecules were grafted onto the surface of Fe@Ag particles to prepare the Fe3O4@Ag@TiO2 nanocomposites. | MIC=1.43 mg mL−1  AE=99.3 % | [1] |
| Ag@Fe3O4 | The magnetic Ag@Fe3O4 antibacterial nanoagent was successfully fabricated using a simple surface functionalization method. By taking advantage of the strong interaction between silver and the amino groups on the surface of Fe3O4 nanospheres, the nanosized silver particles were securely attached to the surface of Fe3O4 nanospheres. | MIC=0.8 mg mL−1  (with in 24 h)  AE=100 % | [2] |
| Fe3O4@Ag | A one-pot thermal decomposition method has been developed to produce a stable aqueous suspension of narrowly dispersed Fe3O4@Ag core-shell nanostructures, which exhibit highly antibacterial and superparamagnetic properties. | MIC=76 μg mL−1  AE=- | [3] |
| Ag/Fe3O4 | The Ag/Fe3O4 nanocoparticles were synthesized using a green approach by employing Mentha extract as a reducing and stabilizing agent. | MIC=-  AE=- | [4] |
| Fe3O4@Ag | The Fe3O4@Ag nanoparticles were prepared using a two-step method, where silver nitrate was reduced on the surface of Fe3O4 nanoparticles through the water-in-oil microemulsion technique. | MIC≥70 μg mL−1  AE=- | [5] |
| Fe3O4@ECS  /PAA-Ag | The Fe3O4 NPs were prepared using a three-step chemical coprecipitation method. Subsequently, the CS coating was immobilized onto the Fe3O4 NPs through acrylic acid polymerization. Finally, the Ag NPs were deposited onto the magnetic nanoparticles by reducing [Ag(NH3)2]+ in situ with poly(vinyl pyrrolidone) as a reductant and stabilizer, while ECS/PAA polymer coating served as a template. | MIC=10 mg mL−1  AE=99.3 % (30 min) | [6] |
| Ag-ZnO | The Ag-ZnO nanocomposites with varied molar ratios were synthesized through simple microwave-assisted reactions using a 1200 W domestic microwave oven (IFB) operating at a frequency of 2.45 × 109 Hz. | MIC=0.55 mg mL−1  AE=- | [7] |
| Ag@Fe3O4 | The synthesis of Ag@Fe3O4 core-shell nanoparticle involves a polyol reduction process by a one-step solvothermal approach. | MIC=0.24 mg mL−1  AE=100 % | This work |

MIC=Minimum Inhibitory Concentration, AE=Antibacterial Efficiency.



**Figure S3**. The UV-vis spectra for the degradation of RB by (a) c-Ag and (b) s-Fe3O4 in the presence of NaBH4 at different time.



**Figure S4**. The digital images showing the degradation process of RB by (a) c-Ag and (b) s-Fe3O4 at different time.



**Figure S5**. The degradation efficiency of c-Ag and s-Fe3O4 towards RB calculated from the UV-vis spectra in **Figure S3**.

**Table S3**. Comparison of the degradation efficiency by various Ag-based nanoparticles towards different dyes.

|  |  |  |  |
| --- | --- | --- | --- |
| Samples | Experimental conditions | Degradation rate | Ref. |
| Fe3O4@SiO2@Ag | NaBH4 | MB~100 % (20 min) | [8] |
| Fe3O4@SiO2-Ag | NaBH4 | RB~100 % (8.5 min) | [8] |
| Ag/Fe3O4/graphene | pH=5  H2O2 | MB~100 % (pH=5)  MB~100 % (H2O2=4 mL) | [9] |
| Ag-Fe3O4 | NaBH4 | RB~100 % (15 min) | [10] |
| Fe3O4@His@Ag | NaBH4 | MB~100 % (4 min) | [11] |
| Ag@CoFe2O4/Fe2O3 | 300 W Xe lamp  30 % H2O2 | R6G~99.15 % (60 min) | [12] |
| Fe3O4/Ag | NaBH4 | RB~85 % (22 min) | [13] |
| Fe3O4-Ag NCs | H2O2 | MB~100 % (49 min) | [14] |
| MPCTP-Ag | NaBH4 | MB~100 % (4 min) | [15] |
| Ag/Fe3O4 | NaBH4 | 4-NP~100 % (5 min) | [16] |
| Ag-Fe3O4 | visible light | MB~3 % (0.0188 M) | [17] |
| Ag@Fe3O4 | NaBH4 | MB~100 % (5 min)  RB~100 % (5 min)  R6G~100 % (5 min) | This work |



**Figure S6**. The possible degradation process of RB by Ag@Fe3O4 in the presence of NaBH4.



**Figure S7**. The possible degradation process of R6G by Ag@Fe3O4 in the presence of NaBH4.



**Figure S8**. The possible degradation process of MB by Ag@Fe3O4 in the presence of NaBH4.

**Table S4**. The industry-level purchasing price of each chemical reagent.

|  |  |  |  |
| --- | --- | --- | --- |
| **Reagents** | **Price per unit**  **(USD, $)** | **One dosage**  **(fully convert into Ag@Fe3O4)** | **Cost for 1000 dosages (USD, $)** |
| Fe(NO3)3·9H2O | 0.21 kg−1 | 1.212 g | 0.25 |
| AgNO3 | 607.76 kg−1 | 0.076 g | 46.49 |
| sodium acetate | 0.22 kg−1 | 2.153 g | 0.47 |
| ethylene glycol | 13.79 ton−1 | 30 mL | 0.46 |
| Ag@Fe3O4 |  | 0.28 g | 280 g |

\* The price is calculated in US dollars ($). It costs $47.67 (0.25 + 46.49 + 0.47 + 0.46 = 47.67) to purchase the Fe(NO3)3·9H2O, AgNO3, sodium acetate, and ethylene glycol to produce 280 g Ag@Fe3O4. The price of Ag@Fe3O4 is $0.17 g−1 in terms of chemical reagents ($47.67 / 280 g = $0.17 g−1). The price of each chemical reagent can be found on [*https://www.1688.com*](https://www.1688.com)*.*

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