Electronic Supplementary Material (ESI) for Nanoscale

Supplementary Information

Excellent surface-enhanced Raman scattering (SERS) based on $AgFeO_2$ semiconductor nanoparticles

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1. UV-vis absorption spectrum of the $AgFeO_2$ nanoparticles

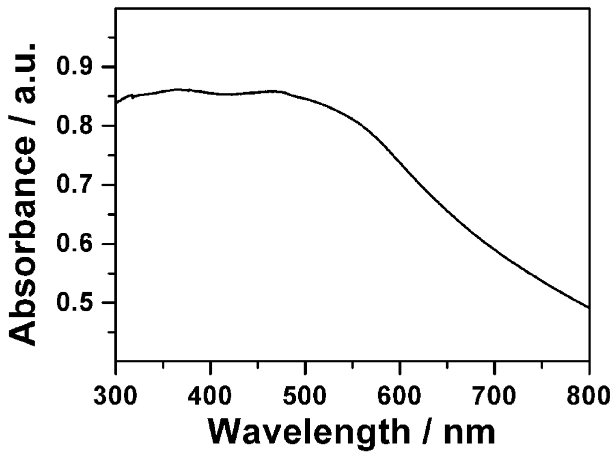

Fig. S1 UV-vis absorption spectrum of the $AgFeO_2$ nanoparticles.

2. Magnetic hysteresis loop of the $AgFeO_2$ nanoparticles

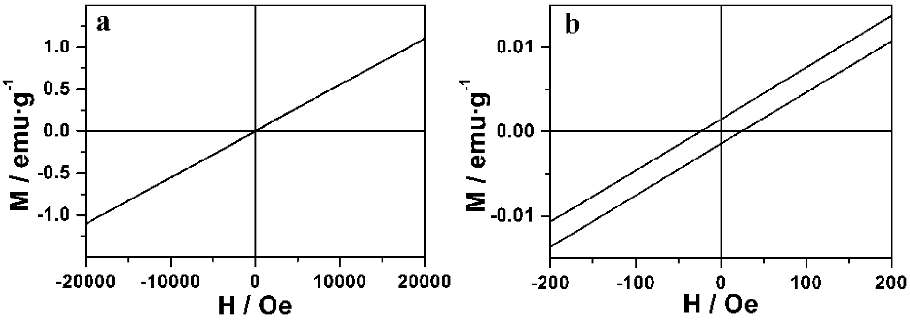

Fig. S2 (a) Magnetic hysteresis loop of the $AgFeO_2$ nanoparticles at room temperature; and (b) an enlarged magnetic hysteresis loop.

3. Raman spectrum of 0.01 M R6G solution

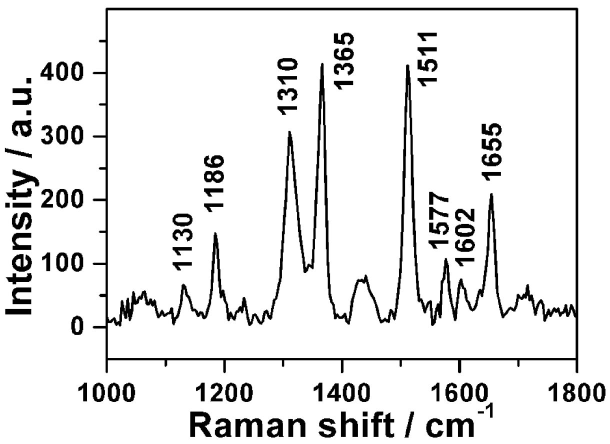

Fig. S3 Raman spectrum of 0.01 M R6G solution.

4. Thermogravimetric analysis (TGA) and differential thermal gravity (DTG) curves of the $AgFeO_2$ nanoparticles

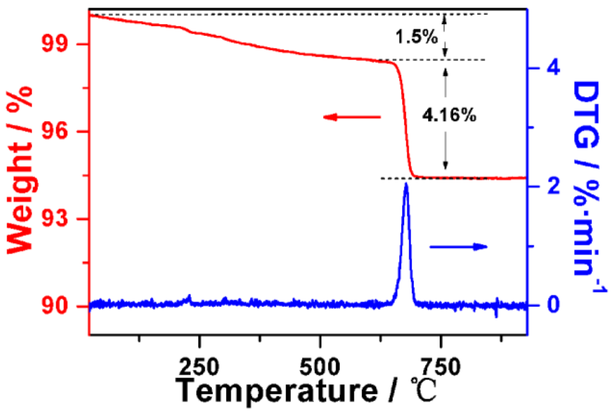

Fig. S4 Thermogravimetric analysis (TGA) and differential thermal gravity (DTG) curves of the $AgFeO_2$ nanoparticles at a heating rate of temperature of 10 °C under air flow.

5. Raman spectrum of 4-MBA powder

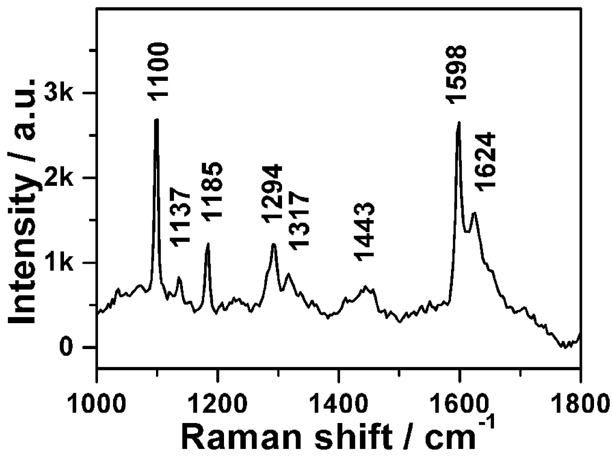

Fig. S5 Raman spectrum of 4-MBA powder.

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6. Enhancement factor (*EF*) calculation:

The average SERS *EF* was calculated according to the formula:

$$EF = \frac{I_{\mathrm{SERS}} N_0}{I_0 N_{\mathrm{SERS}}},$$

where I_0 and I_{SERS} are the peak intensity of the Raman measurement with 0.01 M R6G solution and SERS measurement with 1×10^{-7} M R6G solution, respectively; N_0 and N_{SERS} are the number of R6G molecules in the scattering volume for the Raman measurement and SERS measurement, respectively.

$$N_0 = n_0 N_A = C_0 V_0 N_A;$$

$$N_{SERS} = n_{SERS} N_A = C_{SERS} V_{SERS} N_A;$$

So, $$EF = \frac{I_{SERS} N_0}{I_0 N_{SERS}} = \frac{I_{SERS} C_0 V_0 N_A}{I_0 C_{SERS} V_{SERS} N_A} = \frac{2156 \times 0.01}{422 \times 10^{-7}} = 5.1 \times 10^5,$$

where n_0 and n_{SERS} are the amount substance of R6G molecules in the scattering volume; V_0 and V_{SERS} are the scattering volume ($V_0 = V_{SERS}$); C_0 and C_{SERS} are the concentration of R6G solution. The subscripts 0 and SERS represent Raman measurement and SERS measurement, respectively. *A* is the area of laser spot; *h* is the laser spot depth of focus; N_A is Avogadro constant.

7. The intensity of R6G at various external magnetic fields

The SERS spectra of 1×10^{-7} M R6G solution were collected with $AgFeO_2$ substrate under external magnetic intensity of 0, 2500, 3000, and 3200 Gs. The peak intensities of 1512 cm^{-1} were employed to statistically evaluate the effect of external magnetic field, as shown in Fig. S6. The results show that the SERS intensity increases with the external magnetic field and saturate at 3000 Gs.

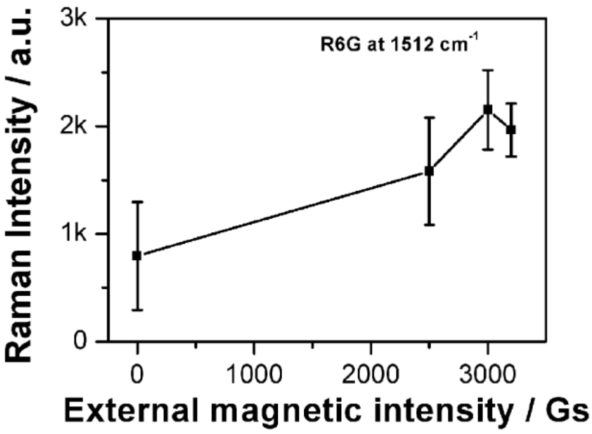

Fig. S6 The effect of external magnetic field on the SERS of 1 × 10^{-7} M R6G solution, using $AgFeO_2$ as substrate.