Supplementary Information

for

Surface-enhanced Raman scattering active substrates from flower-like Ag/ZnO for label-free and sensitive detection of Rhodamine 6G and melamine

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The enhancement factor (EF) = (I_{SERS}/C_{SERS})/(I_{RS}/C_{RS}) is used to obtain the EF of flower-like Ag/ZnO[R10-R13]. Among them, the C_{SERS} (R6G: 50 μg mL^{-1}, Melamine: 1 μg mL^{-1}) and C_{RS} (500 mg mL^{-1}) represent the concentration of analytes. The I_{SERS} represent the SERS intensity of analytes under flower-like Ag/ZnO as SERS substrate. And I_{RS} is the Raman intensity of analytes under the non-SERS substrate. Thus, the EF of R6G and melamine are estimated to be 6.6×10^5 and 1.2×10^7, indicating the excellent SERS performance for analytes detection by flower-like Ag/ZnO as SERS substrate.

References

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To investigate the application of the flower-like Ag/ZnO, river water and milk powder were chosen to detect. As shown in Fig. R2, the R6G with the obvious Raman signals was detected. Although some impurities may interfere with the detection of river water samples, the results after spiking showed that the river water with impurities did not affect the detection of R6G. As shown in Fig. R3, the melamine with the obvious Raman signals in the milk powder sample can be detected. The result indicated that the flower-like Ag/ZnO as SERS substrate is suitable for detecting actual complex matrices.

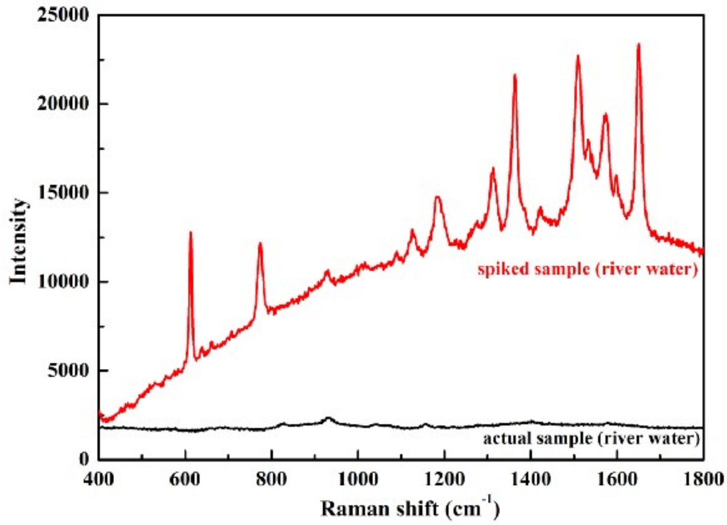

Fig. S1 The SERS spectrum of river water sample with and without R6G (R6G: 500 ng mL^{-1}).

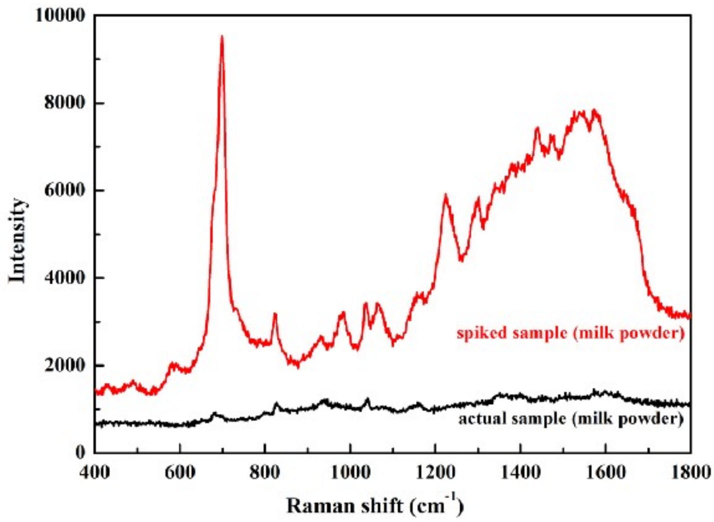

Fig. S2 The SERS spectrum of river water sample with and without melamine (melamine: 500 ng mL^{-1}).

It exhibits the comparison of analytical results of this method and other works found in the literature for the determination of R6G and melamine in Table R1 (Please see Table S1 in the Electronic Supplementary Material). The parameters of analytical range, minimum detection concentration, and enhancement factor of this method were comparable or superable to other results. In addition, compared with other SERS methods, the flower-like Ag/ZnO used in this method has reasonable sensitivity and excellent stability.

Table S1 Comparison of this method with other methods used in the literature

Materials	Analytes	Analytical ranges (mol L^{-1})	Minimum detection concentration (mol L^{-1})	Enhancement factor	Ref.
Au/g-C_3N_4/Ni_3N	R6G Melamine	10^{-6}~10^{-12} 0.5×10^{-7}~1×10^{-6} (0.05~1.0 ppm)	10^{-12} 0.5×10^{-7} (0.05 ppm)	1.82×10^{8} 2.56×10^{7}	S5
$LaVO_4$/Au microspheres	Melamine	1.0×10^{-9}~1.0×10^{-5}	1.0×10^{-9}	-	S6
Ag particles	Melamine	-	1.0×10^{-6}	8.54×10^{5}(Raspberry) 2.01×10^{5}(Shurikent) 2.83×10^{4}(Flower)	S7
Au nanoparticles decorated ZnO/$ZnFe_2O_4$ composite	R6G Melamine	10^{-6}~10^{-12} 3.9×10^{-7}~7.92×10^{-6} (0.39 μM~7.92 μM)	7.92×10^{-6} (0.39 μM)	1.6×10^{8} 1.37×10^{7}	S8
GNS@GEMS	R6G Melamine	1×10^{-4}~1×10^{-9} 1×10^{-6}~5×10^{-5} (0.125 mg/L~6.25 mg/L)	0.1×10^{-9} 8.7×10^{-7} (0.11 mg/L)	2.9×10^{8}	S9
Carboxyl-functionalized Ag-COF	Melamine	7.9×10^{-9}~1.58×10^{-7} (1~20 μg/L)	5.4×10^{-9} (0.68 μg/ L)	2.49×10^{8}	S10
Hollow Au/Ag alloy nanoparticles	R6G Melamine	10^{-6}~10^{-12} 1.0×10^{-7}~1.0×10^{-5} (0.1~10 ppm)	10^{-12} 10^{-9}	-	S11
Magnetic polyphosphazene-Ag composite particles	Melamine	10^{-3}~10^{-7}	10^{-7} mol/L (0.0126 mg/L)	-	S12
Ag NWs	R6G Melamine	10^{-5}~10^{-12} -	1.0×10^{-15} -	9.35×10^{4} -	S13
Flower-like Ag/ZnO	R6G Melamine	1.0×10^{-9}~1.0×10^{-4} (0.5 ng mL^{-1}~50 μg mL^{-1}) 7.9×10^{-9}~7.9×10^{-6} (1 ng mL^{-1}~1 μg mL^{-1})	1.0×10^{-9} (0.5 ng mL^{-1}) 7.9×10^{-9} (1 ng mL^{-1})	6.6×10^{5} 1.2×10^{7}	This work

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