Synchronous Detection of Multi-Heavy Metal ions in Aqueous Solution by Gold Nanoparticles Surface-Enhanced Laser-Induced Breakdown Spectroscopy

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Fig S1 Full spectrum of silicon nitride

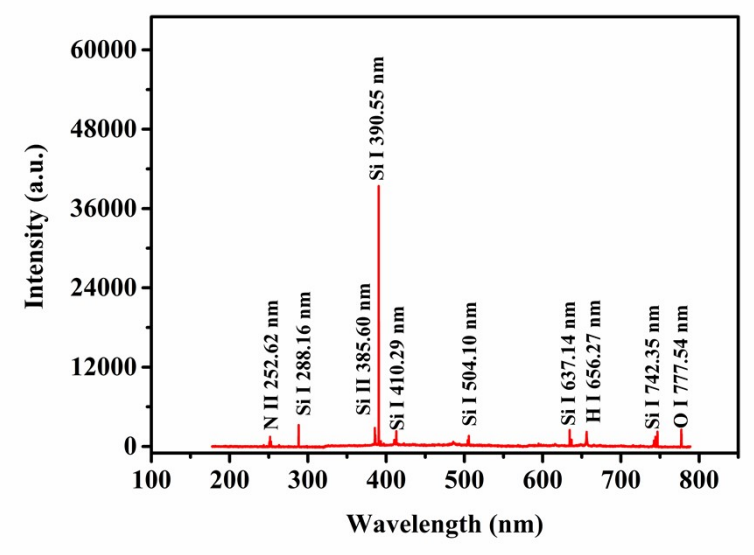

Figure S1 Full spectrum of silicon nitride.

Table S1 The average and the standard deviation of the emission line intensity for the three employed samples (Cu, Pb, and Cr).

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Samples	Cu	Pb	Cr
M	1846±205	963±87	920±150
C-M	7345±614	3509±339	4948±508
28 nm	12567±758	15631±1087	15921±1811
18 nm	14105±1178	18017±1617	18284±1353
13 nm	16494±1216	21728±1257	23799±1976
11 nm	15175±1843	16223±542	20690±1392

The calculation process of AuNPs concentration and number

The concentration of gold particles at 27.78 nm (the density of gold was 19.3 g/cm^3): Mass of a gold particle with a diameter of 27.78 nm: m= $\frac{4\rho\pi r^3}{3} = 2.217 \times 10^{-16} g$; The concentration of 1mL

$HAuCl_4$ solution with mass fraction of 1% was calculated to be about 0.024mol/L; Total mass of gold in 1mL $HAuCl_4$ solution: $m_{Au}=0.024 \times 1.0 \times 10^{-3} \times 197=4.728 \times 10^{-3}$g, The total volume is 50 mL; The approximate molality of AuNPs is $M_{28nm}=m_{Au}/(mxN_AxV)=0.725$ nmol/L (N_A is Avogadro constant: $6.02x10^{23}$); By analogy, then: The approximate molality of AuNPs (17.88 nm): $M_{28nm}=m_{Au}/(mxN_AxV)=2.72$ nmol/L; AuNPs (12.78 nm): $M_{28nm}=m_{Au}/(mxN_AxV)=7.54$ nmol/L; AuNPs (11.11 nm): $M_{28nm}=m_{Au}/(mxN_AxV)=11.30$ nmol/L; The number of AuNPs on the surface unit is $N = c \times v \times N_A/s$=$7.72 \times 10^{10}$, 2.90×10^{11}, 8.03×10^{11}, and 1.20×10^{12} (n◦AuNPs/cm^2), respectively.

Table S2 Physical parameters of Cu (I), Pb (I), and Cr (I) lines.

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species	λ (nm)	g_m	A_{mn} (*$10^7 s^{-1}$)	E_m (cm^{-1})
Cu I	465.112	8	3.80	62403.33
Cu I	510.554	4	0.20	30783.70
Cu I	515.324	4	6.00	49935.20
Cu I	521.820	6	7.50	49942.05
Pb I	357.273	5	9.90	49439.62
Pb I	363.959	3	3.40	35287.22
Pb I	367.149	5	4.40	48686.93
Pb I	368.346	1	13.70	34959.91
Pb I	373.994	5	7.30	48188.63
Pb I	401.963	7	0.35	46328.67
Pb I	405.781	3	9.00	35287.22
Pb I	416.803	2	0.12	45443.17
Pb I	500.542	3	2.70	49439.62
Cr I	357.870	9	14.80	27935.24
Cr I	359.349	3	15.00	27820.20
Cr I	360.533	5	13.10	27728.81
Cr I	425.434	9	3.15	23498.82
Cr I	427.480	7	3.06	23386.34
Cr I	428.972	5	3.06	23305.00
Cr I	520.451	3	5.08	26801.90

Table S3 Calculation of plasma temperature and electron density for Cu, Pb, and Cr.

Element	AuNPs sizes (nm)	Plasma temperature (10^3K)	Electron density ($10^{16} cm^{-3}$)
Cu	28	10.07±0.38	4.18±0.27
Cu	18	10.27±0.21	4.13±0.26
Cu	13	10.51±0.11	4.29±0.27
Cu	11	10.57±0.15	4.19±0.27
Pb	28	9.01±0.21	5.46±0.13
Pb	18	9.18±0.19	5.28±0.12
Pb	13	10.37±0.12	5.37±0.13
Pb	11	10.37±0.12	5.42±0.12

Cr	28	4.27±0.27	7.57±0.12
Cr	18	4.65±0.19	7.28±0.12
Cr	13	4.28±0.19	7.55±0.11
Cr	11	4.56±0.26	7.60±0.12