Electronic supplementary information

Role of 5-thio-(2-nitrobenzoic acid)-capped gold nanoparticles in the sensing of chromium(VI): remover and sensor

Yi-Jhen Lai and Wei-Lung Tseng*.

Department of Chemistry, National Sun Yat-sen University, Taiwan

Correspondence: Dr. Wei-Lung. Tseng, Department of Chemistry, National Sun Yat-sen University, 70, Lien-hai Road, Kaohsiung, Taiwan 804.
E-mail: tsengwl@mail.nsysu.edu.tw
Fax: 011-886-7-3684046.

Experimental Section

Synthesis of citrate-capped AuNPs. Citrate-capped AuNPs were prepared by the chemical reduction of metal salt precursor (hydrogen tetrachloroaurate, $HAuCl_4$) in a liquid phase. Briefly, we rapidly added trisodium citrate (20 mL, 38.8 mM) to a solution of $HAuCl_4$ (200 mL, 1 mM) and heated the resulting solution under reflux for an additional 15 min. TEM images showed that the diameter of the AuNPs was 13 ± 1 nm. The surface plasmon resonance (SPR) wavelength of citrate-capped AuNPs was 520 nm. Using Beer's law, the particle concentration of citrate-capped AuNP solution was determined to be 13 nM; the extinction coefficient of 13 nm AuNPs at 520 nm is 2.7×10^8 M^{-1} cm^{-1}.

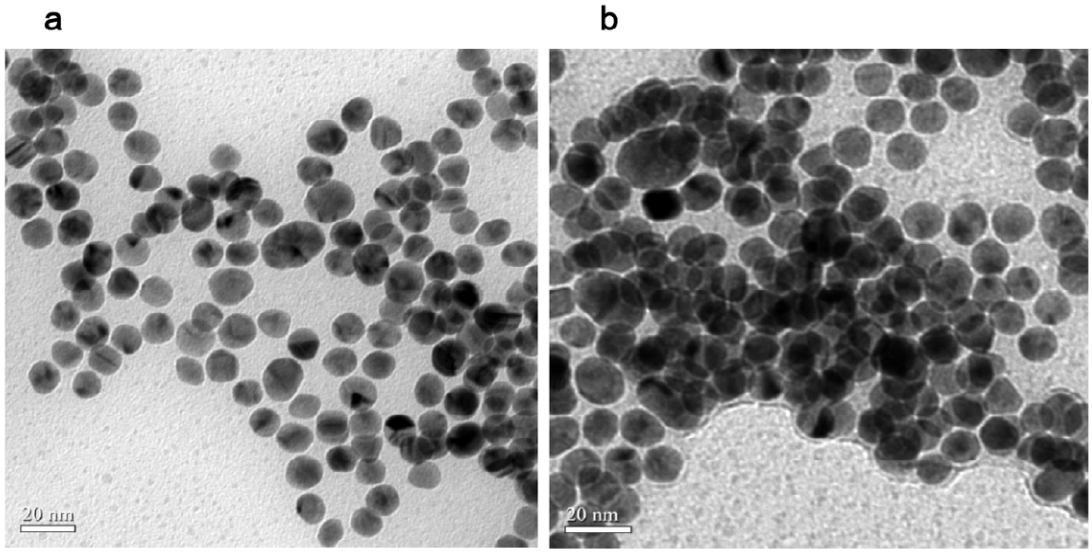

Figure S1. TEM images of solutions of 130 pM TNBA-AuNPs after the addition of (a) 10 μM Cr(VI) and (b) 10 μM Cr(VI) and 5 mM AA. The incubation time between Cr(VI) and AA was 10 min. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5. TNBA-AuNPs are incubated with Cr(VI) and AA-treated Cr(VI) for 10 min, respectively.

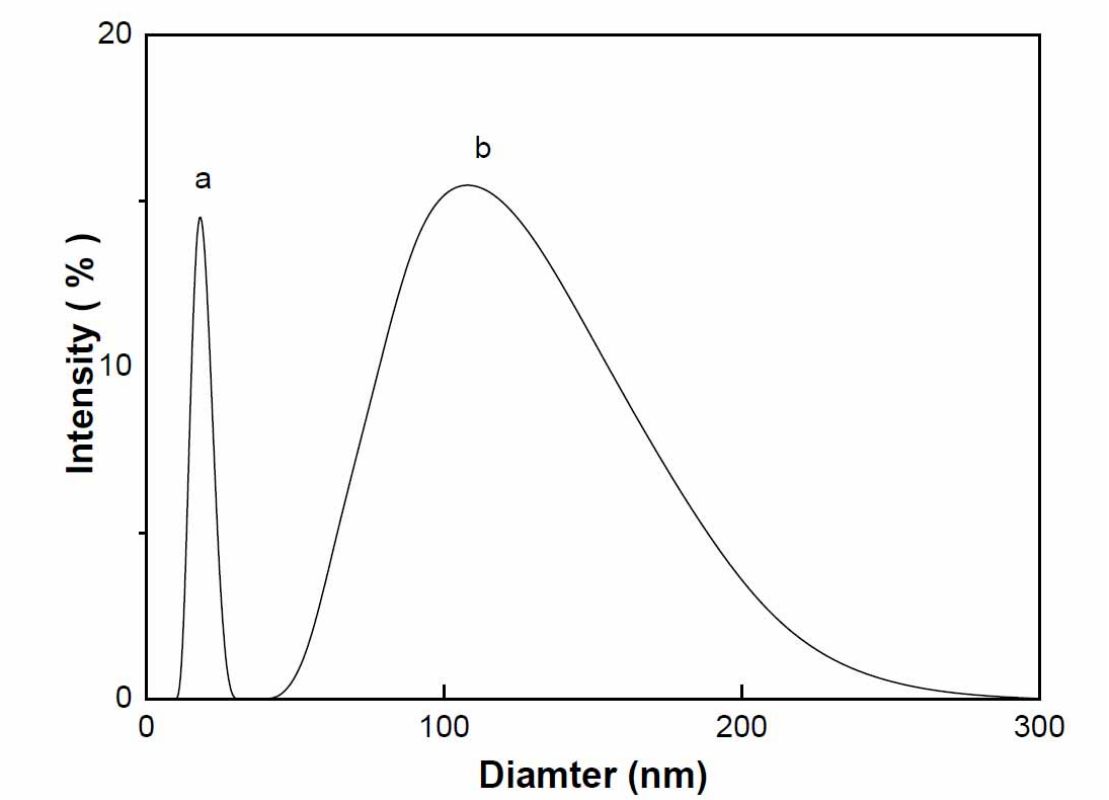

Figure S2. DLS spectra of solutions of 130 pM TNBA-AuNPs after the addition of (a) 10 μM Cr(VI) and (b) 10 μM Cr(VI) and 5 mM AA. The incubation time between Cr(VI) and AA was 10 min. TNBA-AuNPs are prepared in 90 mM HEPES at pH 7.5. TNBA-AuNPs were incubated with Cr(VI) and AA-treated Cr(VI) for 10 min, respectively.

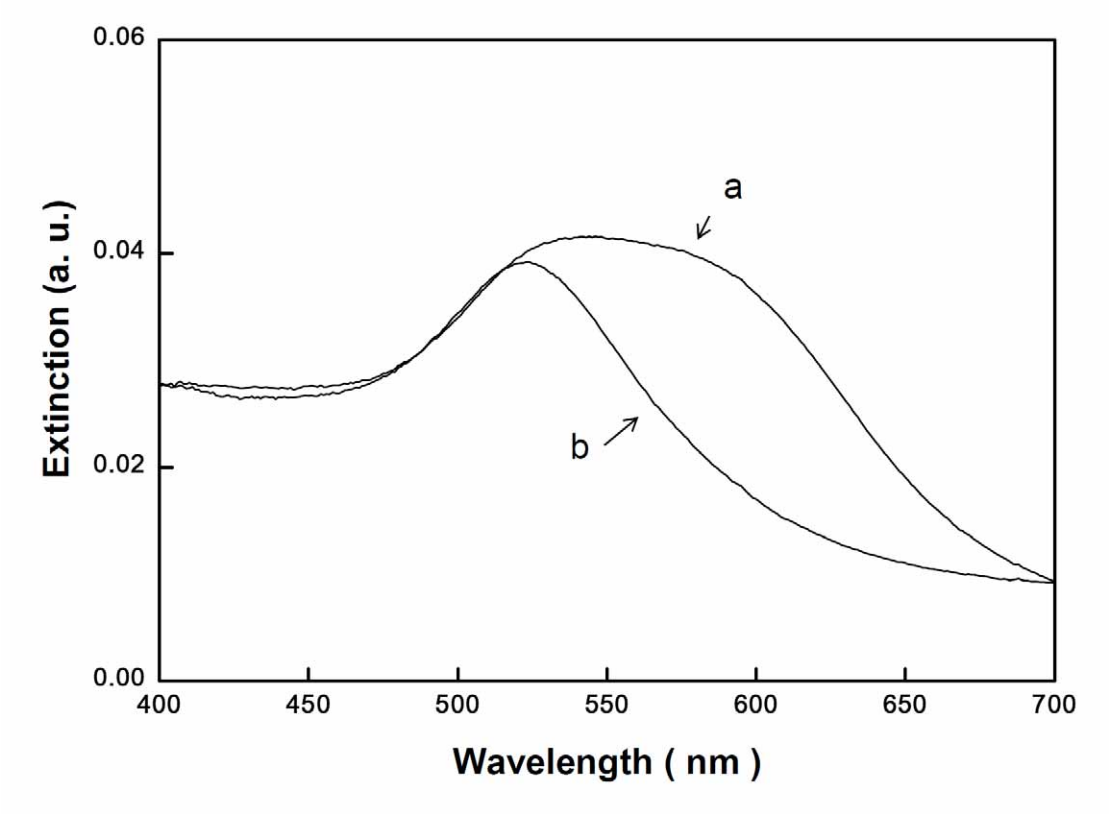

Figure S3. Extinction spectra of solutions of the TNBA-AuNPs after incubating 130 pM TNBA-AuNPs with (a) 10 μM Cr(III) and (b) supernatant for 10 min. The supernatant was obtained by centrifuging a solution of 10 μM Cr(III) and 2 nM TNBA-AuNPs. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5.

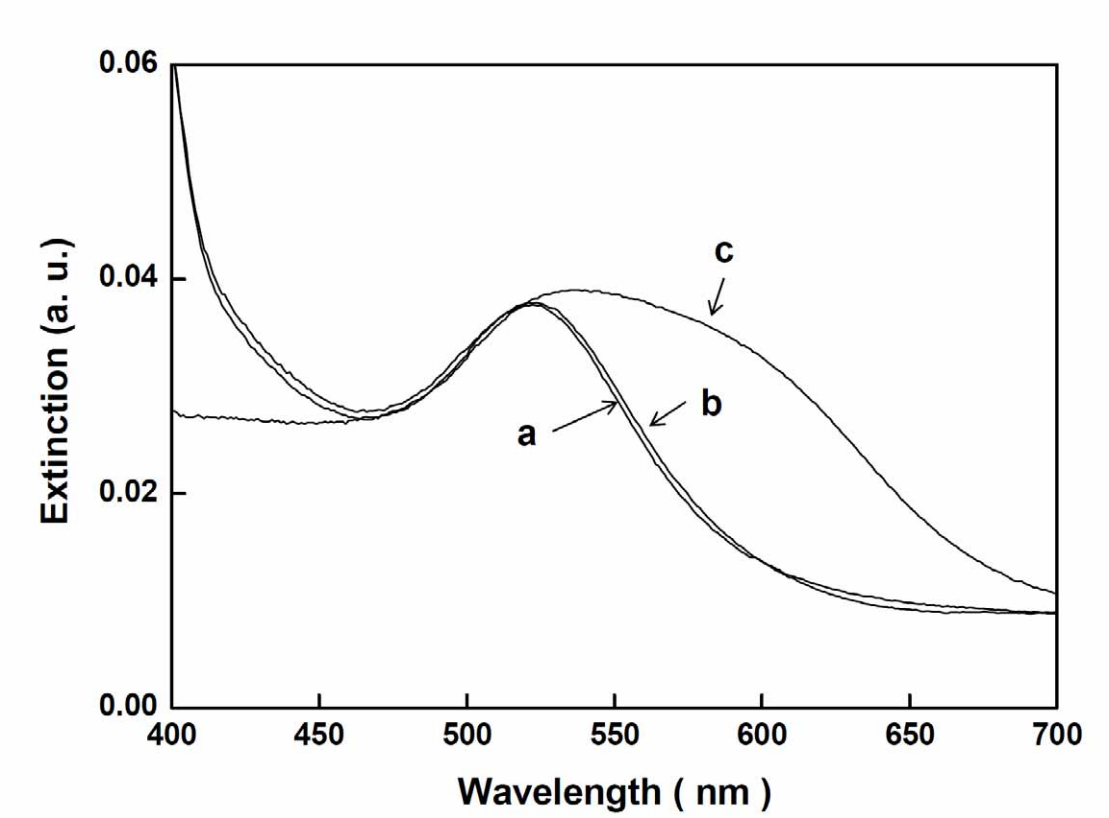

Figure S4. Extinction spectra of solutions of the AuNPs after incubating 130 pM TNBA-AuNPs with (a) 10 μM Cr(VI), (b) supernatant, and (c) AA-treated supernatant for 10 min. (b, c) The supernatant was obtained by centrifuging a solution of 10 μM Cr(VI) and 2 nM TNBA-AuNPs. (c) The obtained supernatant was treated with 5 mM AA for 10 min. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5.

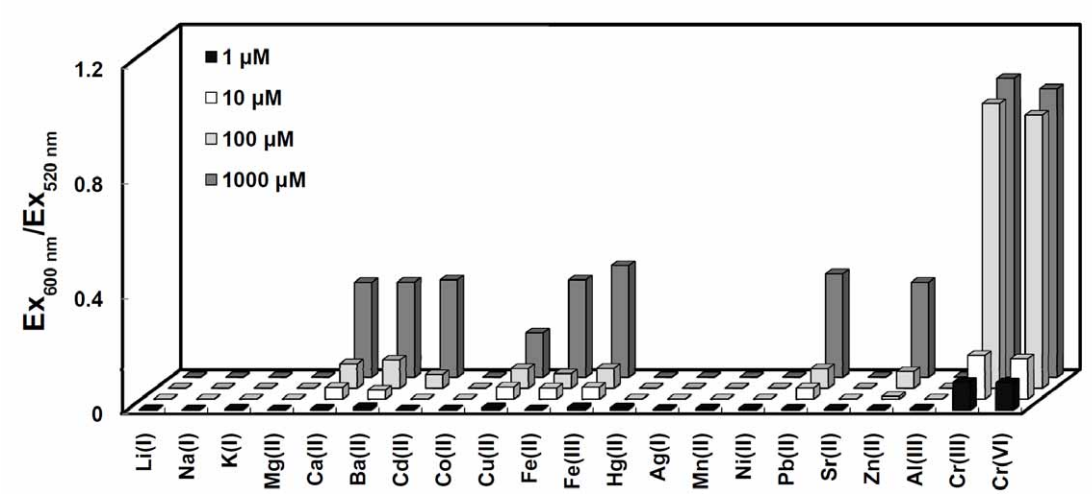

Figure S5. The value of $Ex_{600\ nm}/Ex_{520\ nm}$ of 130 pM TNBA-AuNPs after the addition of a solution containing 1−1000 μM metal ion and 5 mM AA. The metal ions were incubated with 5 mM AA for 10 min. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5.

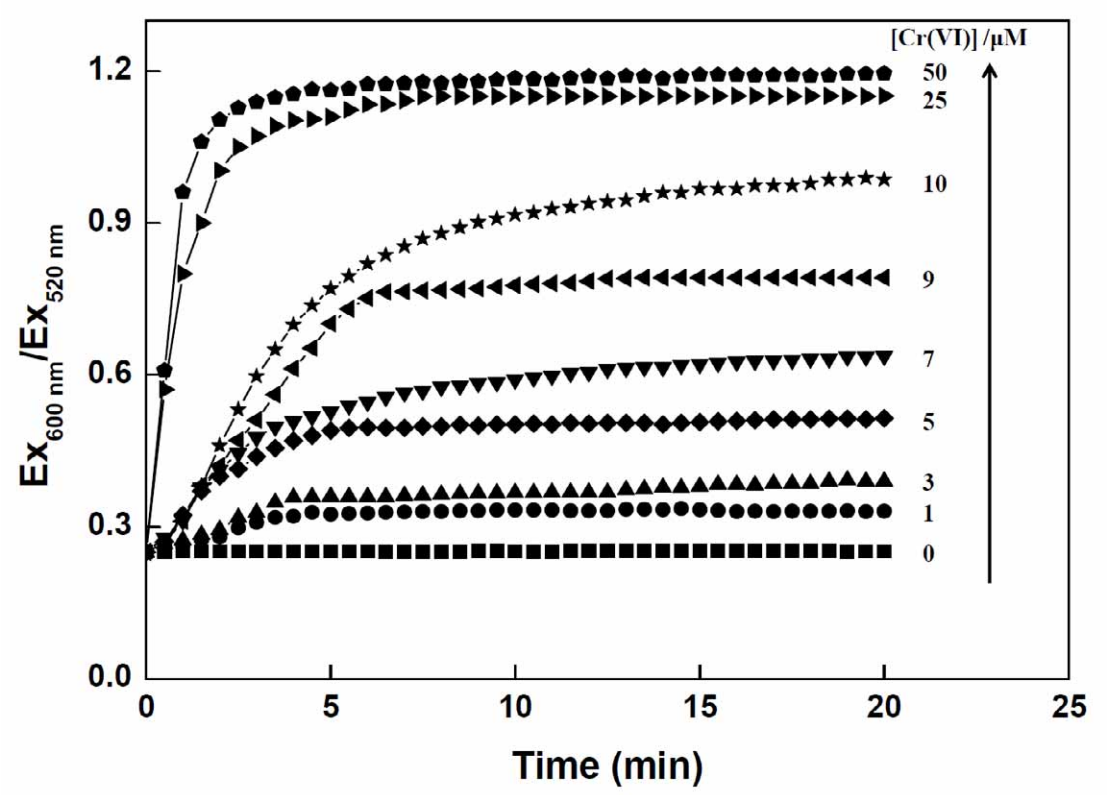

Figure S6. Time course measurement of the value of $Ex_{600\ nm}/Ex_{520\ nm}$ of the AuNPs after incubating 130 pM TNBA-AuNPs with AA-treated supernatant for 0–20 min. The supernatant was obtained by centrifuging a solution of 0–50 μM Cr(VI) and 2 nM TNBA-AuNPs. The supernatant was then treated with 5 mM AA for 10 min. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5.

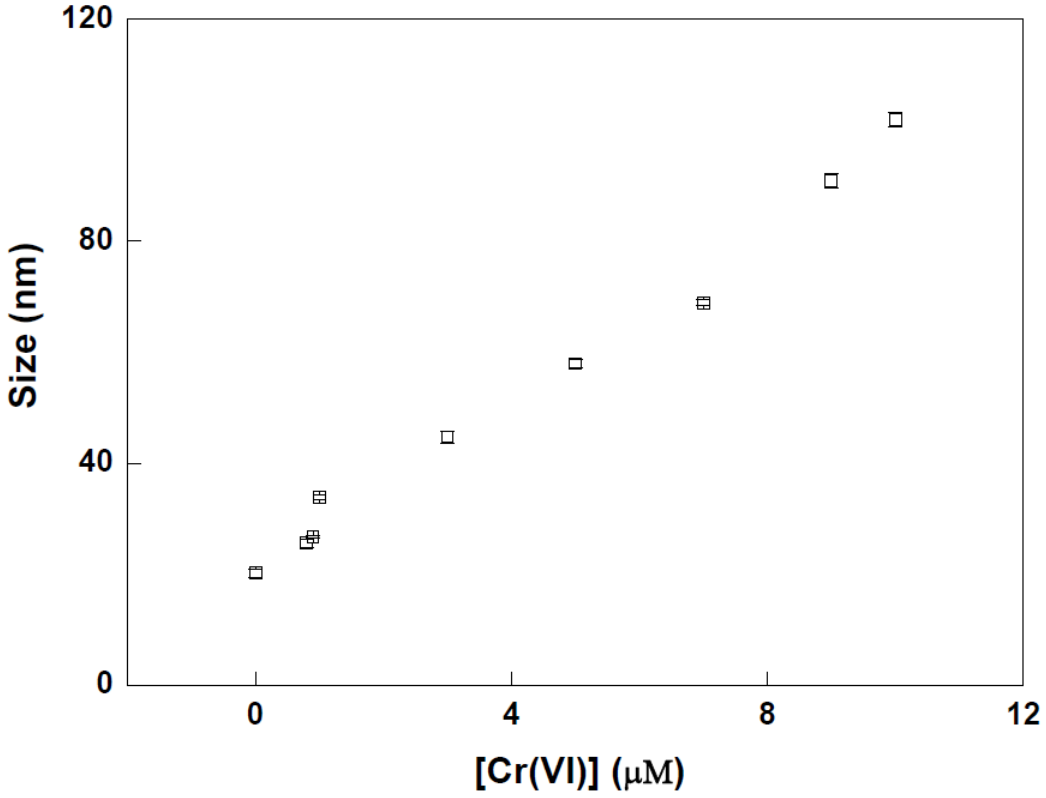

Figure S7. Hydrodynamic size of the AuNPs after incubating 130 pM TNBA-AuNPs with AA-treated supernatant for 10 min. The supernatant was obtained by centrifuging a solution of 0–10 μM Cr(VI) and 2 nM TNBA-AuNPs. The supernatant was then treated with 5 mM AA for 10 min. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5. The error bars represent standard deviations based on three independent measurements.

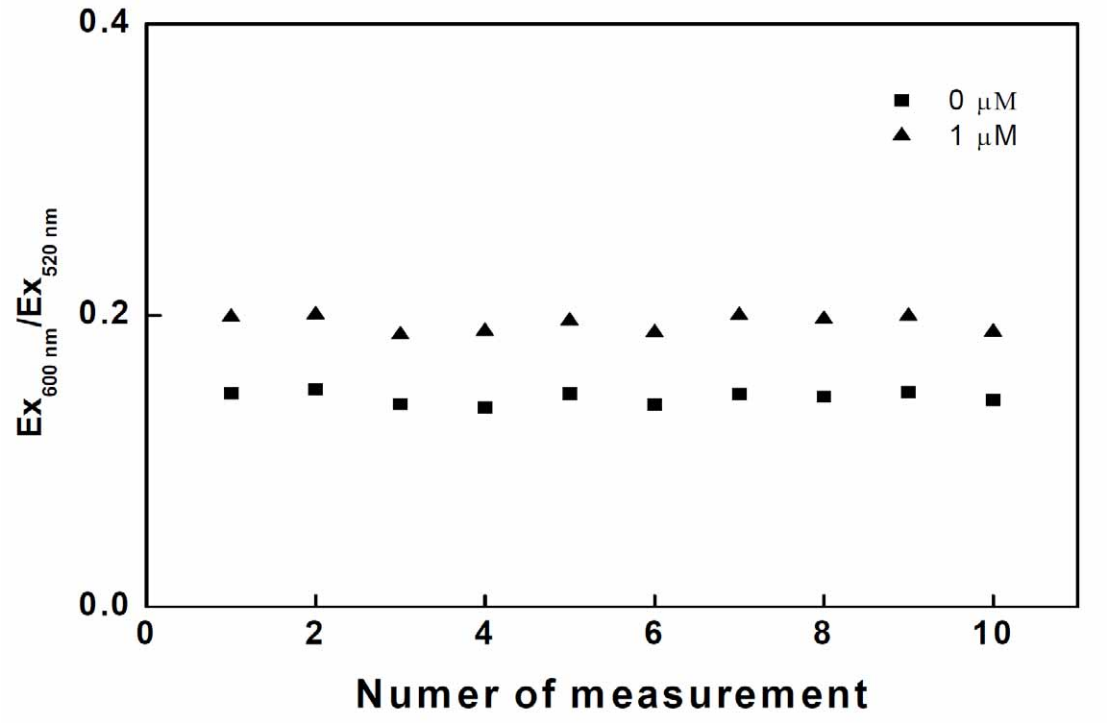

Figure 8. Ten replicate measurements of 0 and 1 μM Cr(VI) using two-step process. The supernatant was obtained by centrifuging a solution of 1 μM Cr(VI) and 2 nM TNBA-AuNPs. The supernatant was then treated with 5 mM AA for 10 min. The AA-treated supernantant was detected using 130 pM TNBA-AuNPs. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5.

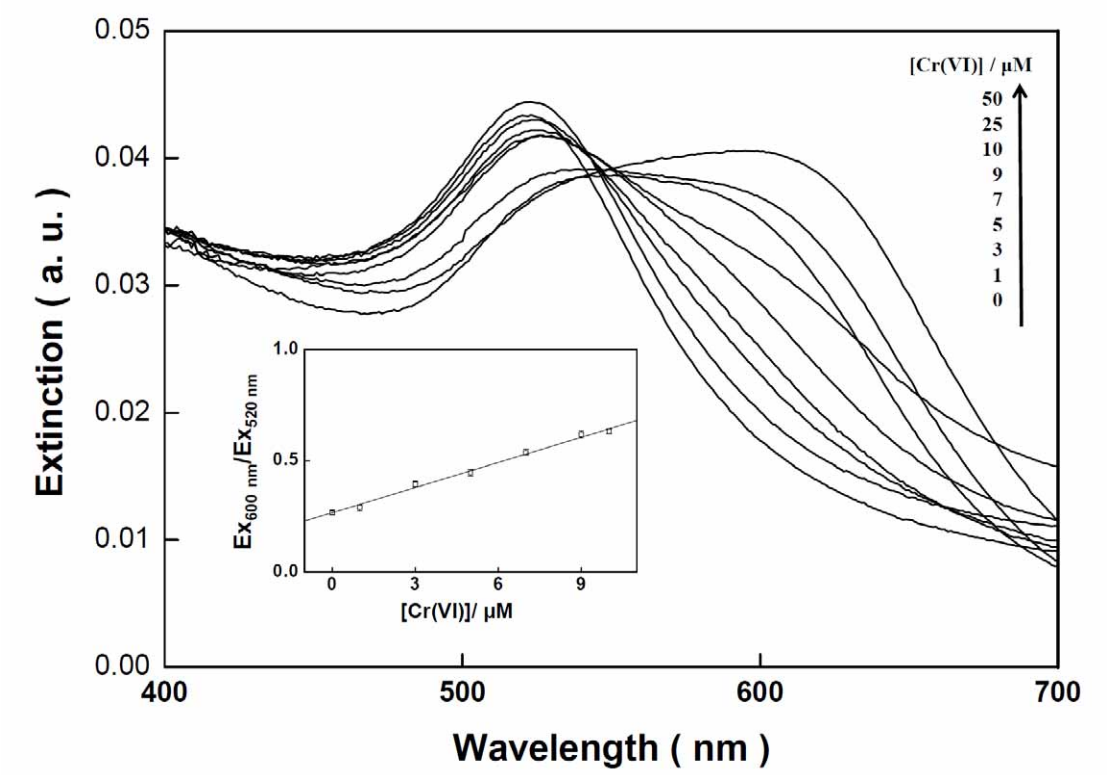

Figure S9. Colorimetric detection of Cr(VI) in drinking water. Drinking water samples were spiked by standard solutions containing 0–50 μM Cr(VI). The supernatant was obtained by centrifugation of a solution containing the spiked drinking water and 2 nM TNBA-AuNPs. The supernatant was then treated with 5 mM AA for 10 min. The AA-treated supernatant was detected using 130 pM TNBA-AuNPs. The incubation time between AA-treated supernatant and TNBA-AuNPs was 10 min. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5. Inset: a plot of the value of $Ex_{600\ nm}/Ex_{520\ nm}$ versus the concentration of Cr(VI). The error bars represent standard deviations based on three independent measurements.

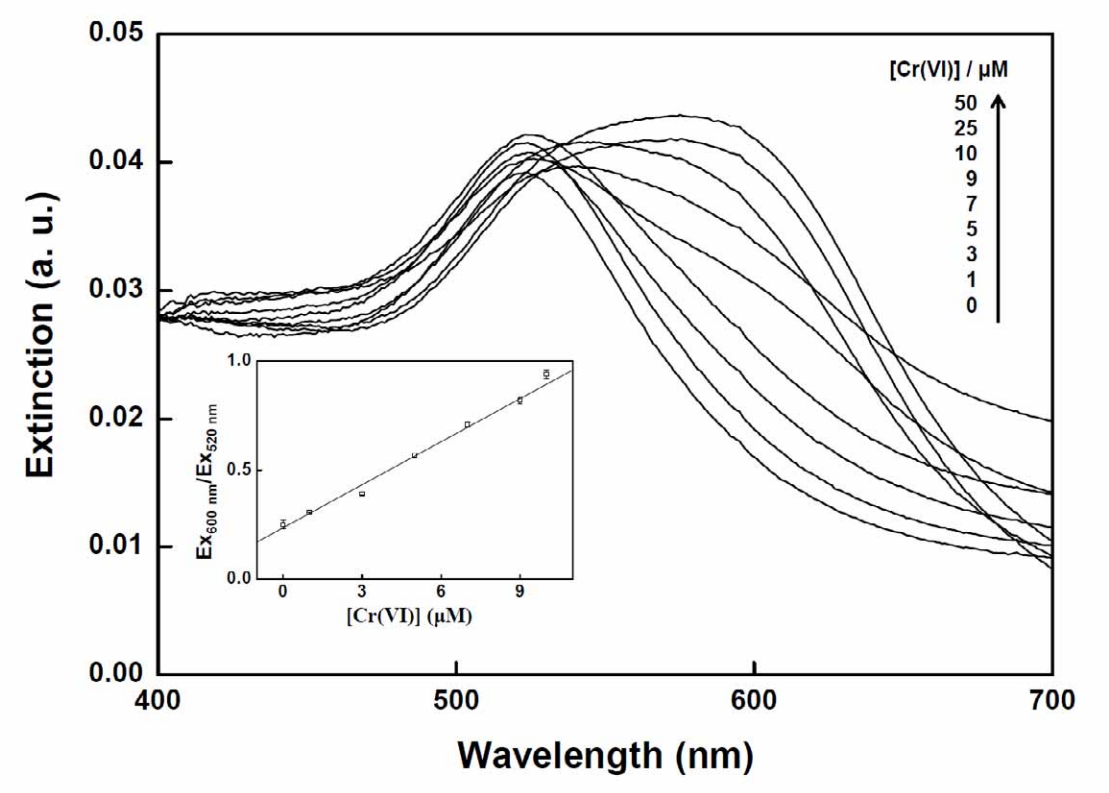

Figure S10. Colorimetric detection of Cr(VI) in tap water. Tap water samples were spiked by standard solutions containing 0–25 μM Cr(VI). The supernatant was isolated by centrifugation of a solution containing the spiked tap water and 2 nM TNBA-AuNPs. The supernatant was then treated with 5 mM AA for 10 min. The AA-treated supernatant was detected using 130 pM TNBA-AuNPs. The incubation time between AA-treated supernatant and TNBA-AuNPs was 10 min. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5. Inset: a plot of the value of $Ex_{600\ nm}/Ex_{520\ nm}$ versus the concentration of Cr(VI). The error bars represent standard deviations based on three independent measurements.

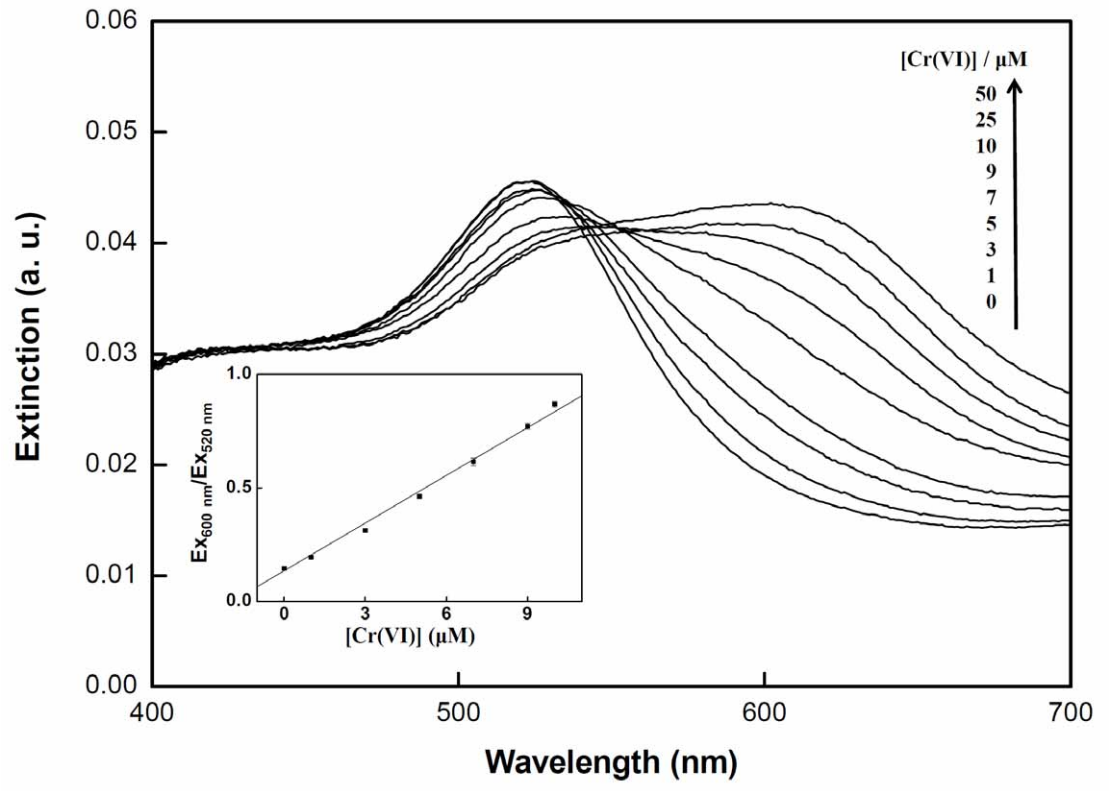

Figure S11. Colorimetric detection of Cr(VI) in lake water. Lake water samples were spiked by standard solutions containing 0–25 μM Cr(VI). The supernatant was isolated by centrifugation of a solution containing the spiked tap water and 2 nM TNBA-AuNPs. The supernatant was then treated with 5 mM AA for 10 min. The AA-treated supernatant was detected using 130 pM TNBA-AuNPs. The incubation time between AA-treated supernatant and TNBA-AuNPs was 10 min. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5. Inset: a plot of the value of $Ex_{600\ nm}/Ex_{520\ nm}$ versus the concentration of Cr(VI). The error bars represent standard deviations based on three independent measurements.

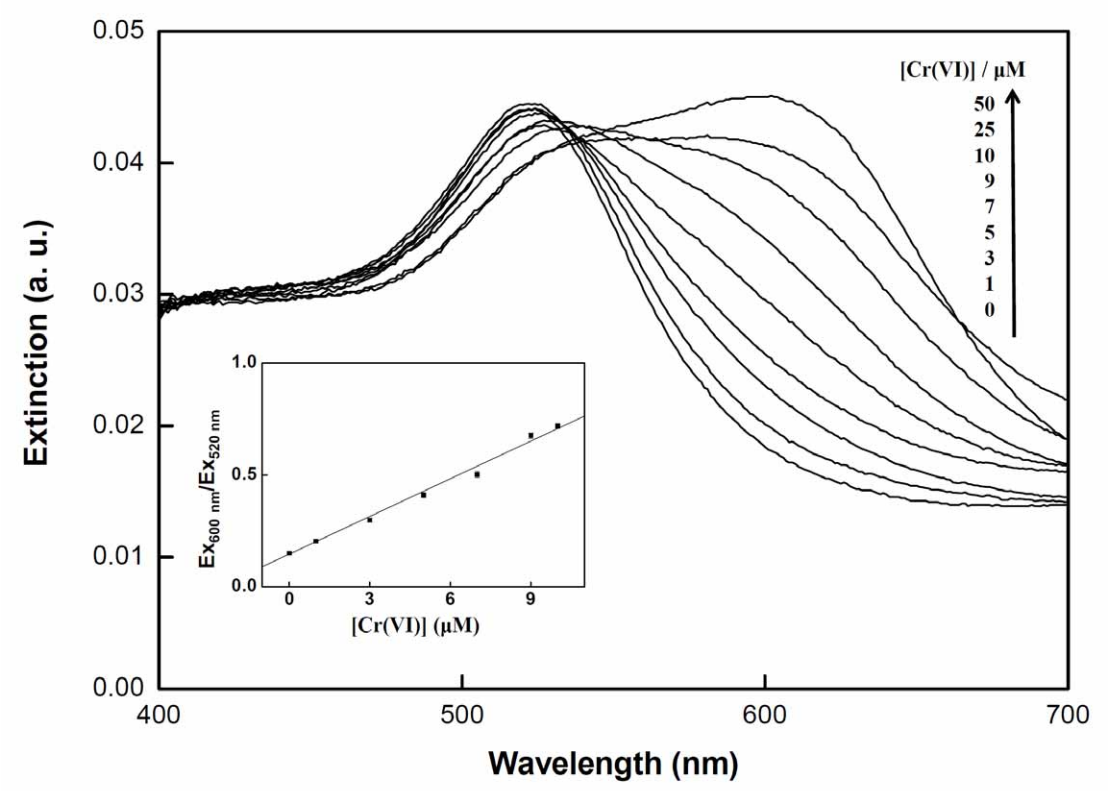

Figure S12. Colorimetric detection of Cr(VI) in river water. River water samples were spiked by standard solutions containing 0–25 μM Cr(VI). The supernatant was isolated by centrifugation of a solution containing the spiked tap water and 2 nM TNBA-AuNPs. The supernatant was then treated with 5 mM AA for 10 min. The AA-treated supernatant was detected using 130 pM TNBA-AuNPs. The incubation time between AA-treated supernatant and TNBA-AuNPs was 10 min. TNBA-AuNPs were prepared in 90 mM HEPES at pH 7.5. Inset: a plot of the value of $Ex_{600\ nm}/Ex_{520\ nm}$ versus the concentration of Cr(VI). The error bars represent standard deviations based on three independent measurements.