**Supporting Information**

**Fig. S1.** Fluorescence spectra of Tris-acetate solutions (5 mM, pH 8.0) containing AUR (10 μM), H₂O₂ (0.4 mM) and (a) T30695 (100 nM), (b) citrate-capped Au NPs (0.3 nM), or (c) 40T30695–Au NPs (0.3 nM) in the presence of Pb²⁺ ions (100 nM). Inset: Photograph of the fluorescence of the solutions upon excitation under a hand-held UV lamp (365 nm). Other conditions were the same as those described in Figure 1.
**Fig. S2.** XPS spectra of the (a) citrate-capped Au NPs (14.9 nM, 30 μL) and (b) 40T30695–Au NPs (14.9 nM, 30 μL) reveals the signals for the Au 4f\textsubscript{7/2} electrons in the (i) absence and (ii) presence of Pb\textsuperscript{2+} ions (1 μM) respectively. As well as for the (c) Pb 4f\textsubscript{7/2} electrons in the presence of Pb\textsuperscript{2+} ions (15 μM) of (i) citrate-capped Au NPs and (ii) 40T30695–Au NPs respectively.
Fig. S3. SALDI mass spectra of solutions containing Tris-acetate buffers (5 mM, pH 8.0), (a) 40T30695–Au NPs (7.5 nM) in the absence of Pb$^{2+}$ ions, and (b) citrate-capped Au NPs (7.5 nM) in the presence of Pb$^{2+}$ ions (10 μM). The asterisk (*) represent unknown peaks. (a) The peak at m/z 196.94 is assigned to [Au]$^+$ ions, (b) The peak at m/z 196.96, 393.93, (205.95, 206.95, 207.96) and (402.92, 403.92, 404.92) are assigned to [Au]$_1^+$, [Au]$_2^+$, [Pb]$^+$ and [Au+Pb]$^+$ ions, respectively. In total, 300 pulsed laser shots were applied under a laser fluence of 62.5 μJ. Other conditions were the same as those described in Figure 2.
**Fig. S4.** (a) Transmission electron microscopy (TEM) and (b) high resolution transmission electron microscopy (HRTEM) images of 40T30695–Au NPs (0.3 nM) in the (i) absence and (ii) presence of Pb$^{2+}$ ions (10 μM). Other conditions were the same as those described in Figure 1. Average Au NP sizes in Figure S4a(i) and S4a(ii) are 13.6 ± 0.3 and 13.6 ± 0.5 nm, respectively. The lattice fringes in both (a) and (b) are consistent with metallic gold having a discerned lattice spacing of 2.4 Å, which corresponds to the d-spacing of the (111) crystal plane of face-centered cubic (fcc) Au.
Fig. S5. XRD patterns of (a) citrate-capped Au NPs (60 nM) and (b) 40T30695–Au NPs (60 nM) in the (i) absence and (ii) presence of Pb$^{2+}$ ions (10 μM), respectively. The asterisk (*) represent unknown peaks.
**Fig. S6.** Circular dichroism (CD) spectra of T30695 and random DNA (rDNA) oligonucleotides (1.0 μM) in the (a) absence and (b) presence of Pb²⁺ (10 μM) ions. Solutions were prepared in 5 mM Tris-acetate (pH 8.0).
**Fig. S7.** Effect of pH (6.0–10.0) on the fluorescence intensity of the 40T30695–Au NP/AUR probe (0.3 nM) in 5 mM Tris-acetate buffer in the absence and presence of Pb$^{2+}$ ions (100 nM). Other conditions were the same as those described in Figure 1. $I_{F0}$ and $I_F$ are the fluorescence intensities of the solutions in the absence and presence of Pb$^{2+}$ ions, respectively.
Fig. S8. Validation of the 40T30695–Au NP/AUR probe for the sensing of Pb\(^{2+}\) ions (0–1 \(\mu\)M) in 5 mM Tris-acetate solutions (pH 8.0) containing (a) 150 mM NaCl, 5 mM KCl, 1 mM MgCl\(_2\), and 1 mM CaCl\(_2\) or (b) 10 \(\mu\)M cysteine. Other conditions were the same as those described in Figure 1.
Fig. S9. Blood sample analysis of a healthy adult male (25 years old) using the 40T30695–Au NP/AUR probe. Aliquots of the diluted (3-fold) blood sample were spiked with Pb$^{2+}$ ions at concentrations between 0–50 nM. Other conditions remains the same as those described in Figure 1.