**Fig. S1** UV–Vis absorbance spectra of 5.0 mM Tris-borate (pH 7.0) containing Au NPs (750 pM) in the (A) absence and (B–F) presence of (B) Ag$^+$ (10 μM), (C) Bi$^{3+}$ (10 μM), (D) Pb$^{2+}$ 10 μM), (E) Pt$^{4+}$ (10 μM), and (F) Hg$^{2+}$ (10 μM).
Fig. S2 (a) TEM and (b) HRTEM images of Au NPs in the (A) absence and (B–F) presence of (B) Ag⁺, (C) Bi³⁺, (D) Pb²⁺, (E) Pt⁴⁺, and (F) Hg²⁺. Other conditions were the same as those described in Fig. S1. Average Au NP sizes in (a) (A–F) are 13.4 ± 1.2, 13.8 ± 1.0, 13.4 ± 1.2, 13.4 ± 1.1, 13.4 ± 1.9, and 13.3 ± 1.7 nm, respectively. The lattice fringes in (A–F) are consistent with metallic Au having a discerned lattice spacing of 2.4 Å, corresponding to the \(d\)-spacing of the (111) crystal plane of face-centered cubic (fcc) Au.
Fig. S3 Au 4f core-level photoelectron spectra of Au NPs (750 pM) in the (A) absence and (B–F) presence of (B) Ag⁺ (10 μM), (C) Bi³⁺ (10 μM), (D) Pb²⁺ (10 μM), (E) Pt⁴⁺ (10 μM), and (F) Hg²⁺ (10 μM) ions, dosed onto Si substrates, and measured at room temperature. Other conditions were the same as those described in Fig. S1. The binding energy (BE, 285.3 eV) of the alkyl chain C 1s orbital is given as an internal reference.
Fig. S4 SALDI mass spectra of 5.0 mM Tris-borate (pH 7.0) containing Au NPs (750 pM) in the (a) absence and (b–f) presence of (b) Ag⁺ (10 μM), (c) Bi³⁺ (10 μM), (d) Pb²⁺ (10 μM), (e) Pt⁴⁺ (10 μM), and (f) Hg²⁺ (10 μM) ions. The peaks in (a) at m/z 196.97, 393.93, and 590.90 are assigned to \([\text{Au}^+]\), \([\text{Au}^2+]\), and \([\text{Au}^3+]\) ions, respectively. The peaks in (b) at m/z 106.90, 108.90, 213.81, 215.81, 217.81, 303.87, 305.87, 410.78, 412.78, 414.78, 500.84, and 502.84 are assigned to \([\text{Ag}^+]\), \([\text{Ag}^2+]\), \([\text{Ag}^3+]\), \([\text{Ag}^4+]\), \([\text{Au} + \text{Ag}^+]\), \([\text{Au} + \text{Ag}^2+]\), \([\text{Au} + \text{Ag}^3+]\), \([\text{Au} + \text{Ag}^4+]\), \([\text{Bi}^+]\), \([\text{Bi}^2+]\), \([\text{Bi}^3+]\), \([\text{Bi}^4+]\), \([\text{Pt}^+]\), \([\text{Pt}^2+]\), \([\text{Pt}^3+]\), \([\text{Pt}^4+]\), \([\text{Pb}^+]\), \([\text{Pb}^2+]\), and \([\text{Hg}^+]\) ions, respectively. Other conditions were the same as those described in Fig. S1. A total of 500 pulsed laser shots were applied under a laser fluence set at 51.25 μJ.
**Fig. S5** UV–Vis absorbance spectra of 5.0 mM Tris-borate (pH 7.0) containing Au NPs (750 pM) in the (A) absence and (B–D) presence of (B) Hg$^{2+}$ (10 µM), (C) Bi$^{3+}$ (10 µM), and (D) Hg$^{2+}$ (10 µM) and Bi$^{3+}$ (10 µM) ions. Other conditions were the same as those described in Fig. S1.
**Fig. S6** UV–Vis absorbance spectra of 5.0 mM Tris-borate (pH 7.0) containing Au NPs (750 pM) in the (A) absence and (B–D) presence of (B) Pt⁴⁺ (10 μM), (C) Hg²⁺ (10 μM), and (D) Pt⁴⁺ (10 μM) and Hg²⁺ (10 μM) ions. Other conditions were the same as those described in Fig. S1.
Fig. S7 SALDI mass spectra of 5.0 mM Tris-borate (pH 7.0) containing Au NPs (750 pM) in the (a) absence and (b–d) presence of (b) Ag⁺ (10 μM), (c) Bi³⁺ (10 μM), and (d) Ag⁺ (10 μM) and Bi³⁺ (10 μM) ions. The peaks in (a) at m/z 196.97, 393.93, and 590.90 are assigned to [Au⁺], [Au₂⁺], and [Au₃⁺] ions, respectively. The peaks in (b) at m/z 106.90, 108.90, 213.81, 215.81, 217.81, 303.87, 305.87, 410.78, 412.78, 414.78, 500.84, and 502.84 are assigned to [106.90Ag⁺], [108.90Ag⁺], [106.90Ag + 106.90Ag]⁺, [106.90Ag + 108.90Ag]⁺, [108.90Ag + 108.90Ag]⁺, [Au₁ + 106.90Ag]⁺, [Au₂ + 106.90Ag]⁺, and [Au₃ + 108.90Ag]⁺ ions, respectively. The peaks in (c) at m/z 208.98, 405.95, 417.96, 602.91, and 614.93 are assigned to [Bi₁⁺], [Au₁Bi₁⁺], [Bi₂⁺], [Au₂Bi₁⁺], and [Au₁Bi₂⁺] ions, respectively. The peaks in (d) at m/z 315.88, 317.88, 524.87, and 526.87 are assigned to [106.90Ag + Bi₁]⁺, [108.90Ag + Bi]⁺, [106.90Ag + Bi₂]⁺, and [106.90Ag + Bi₂]⁺ ions, respectively. Other conditions were the same as those described in Fig. S1. A total of 500 pulsed laser shots were applied under a laser fluence set at 51.25 μJ.