Supplementary Information

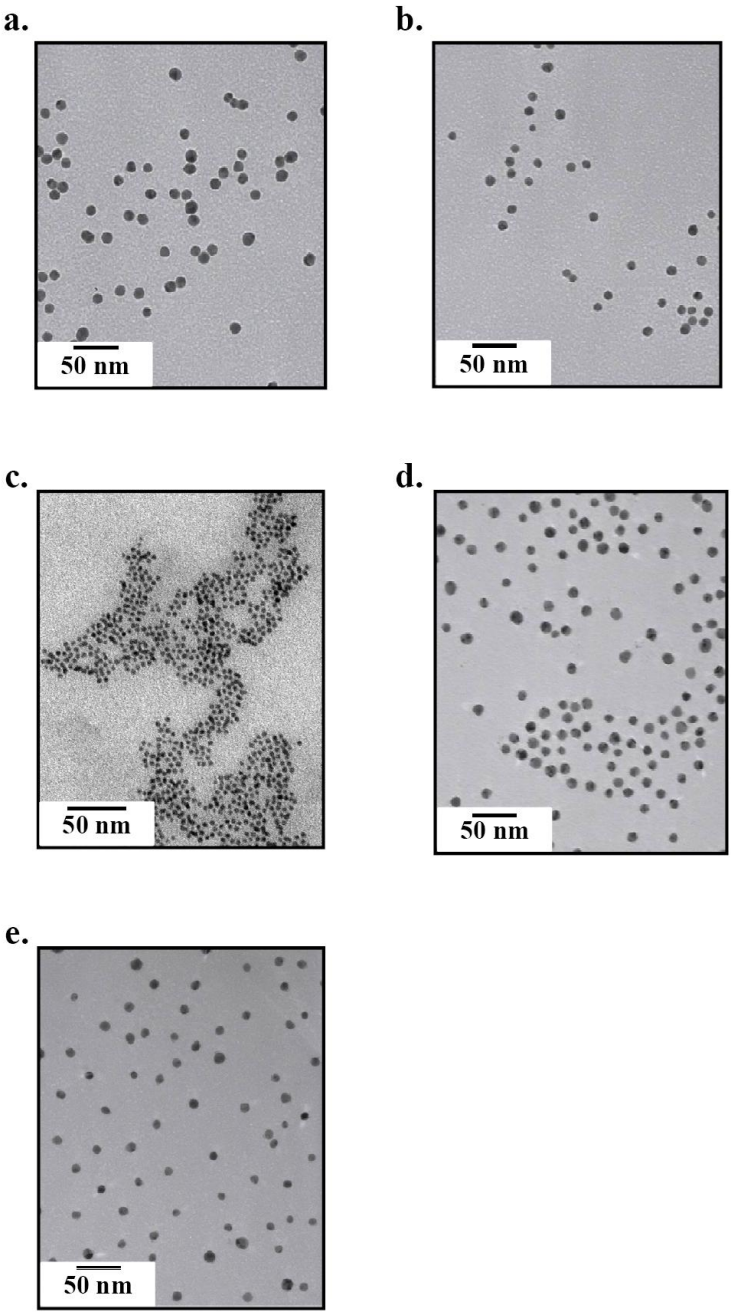

Fig. S1 Transmission electron microscopy (TEM) images of the Au NPs in samples of (a) BSA-Au NPs, (b) BSA-Au NPs and 2-ME; (c) BSA-Au NPs, 2-ME, and $PbCl_2$; (d) BSA-Au NPs, 2-ME, $PbCl_2$, and $Cu(NO_3)_2$; (e) BSA-Au NPs, 2-ME, and $Cu(NO_3)_2$, all in a PDCA solution. The average particle sizes were obtained from counts of 100 particles in the TEM images. Other conditions were the same as those described in Figure 1. The particle sizes of Au NPs in a, b, c, d, and e were 13.3 ± 0.6, 12.2 ± 0.5, 3.5 ± 0.5, 12.7 ± 0.6, and 10.2 ± 0.4, respectively. The average sizes of the Au NPs were determined from 100 particle counts.

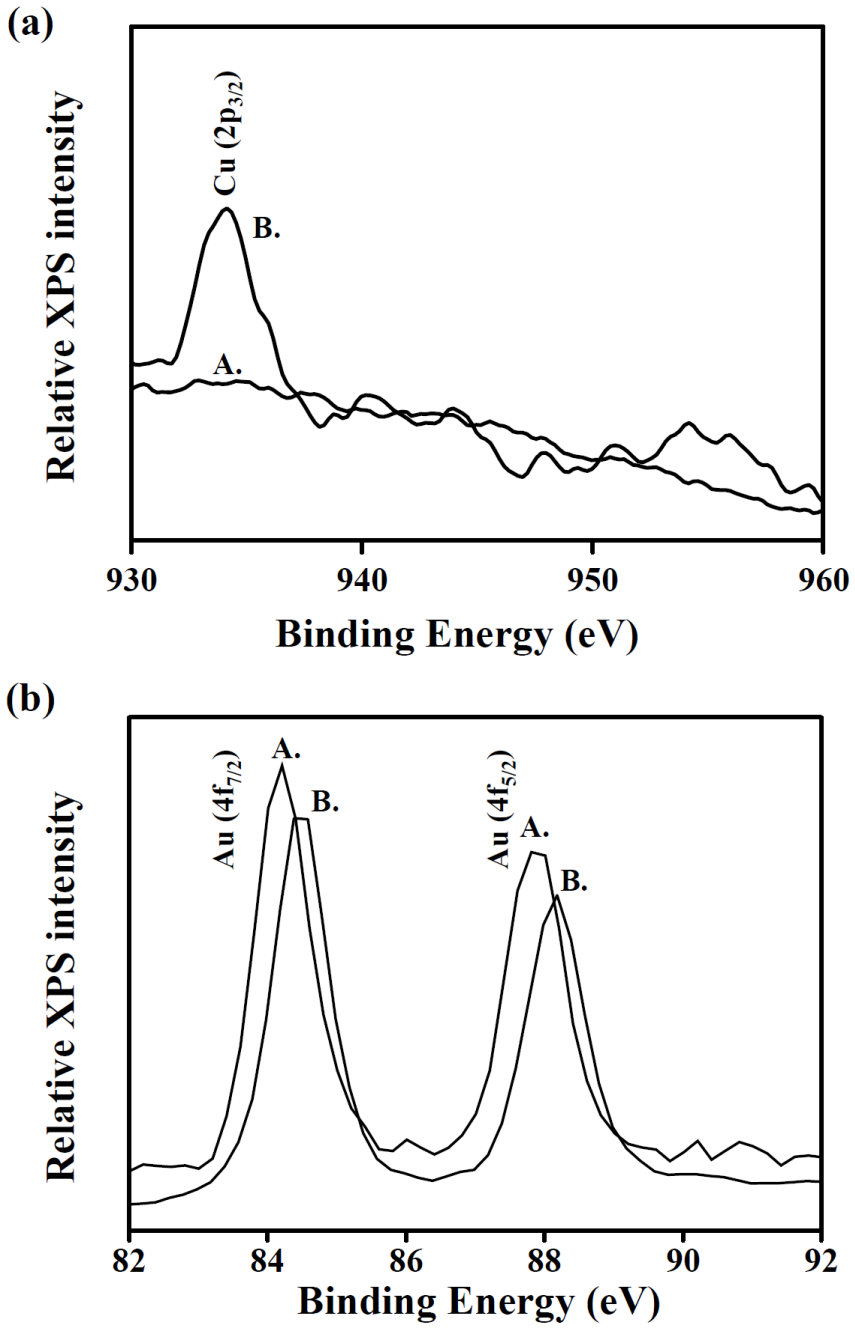

Fig. S2 (a) Cu ($2P_{3/2}$) and (b) Au (4f) core-level photoelectron spectra of BSA-Au NPs in the (A) absence and (B) presence of Cu^{2+} (10 μM), 2-ME (1.0 M), and Pb^{2+} (50 μM) in 5 mM glycine–NaOH solution (pH 12.0). The sample dosed onto silicon substrates and measured at room temperature. Other conditions were the same as those described in Figure 1.

The XPS used to measure the binding energy (BE) of the Au $4f_{7/2}$ electrons in the BSA-Au NPs in the absence and presence of Cu^{2+} ions; the values of 84.1 and 84.4 eV, respectively, revealed the increased oxidation state of the Au NP surfaces in the presence of Cu^{2+} ions. That is, because of the formation of the Au-Cu bonds, the oxidation state of Au increased.

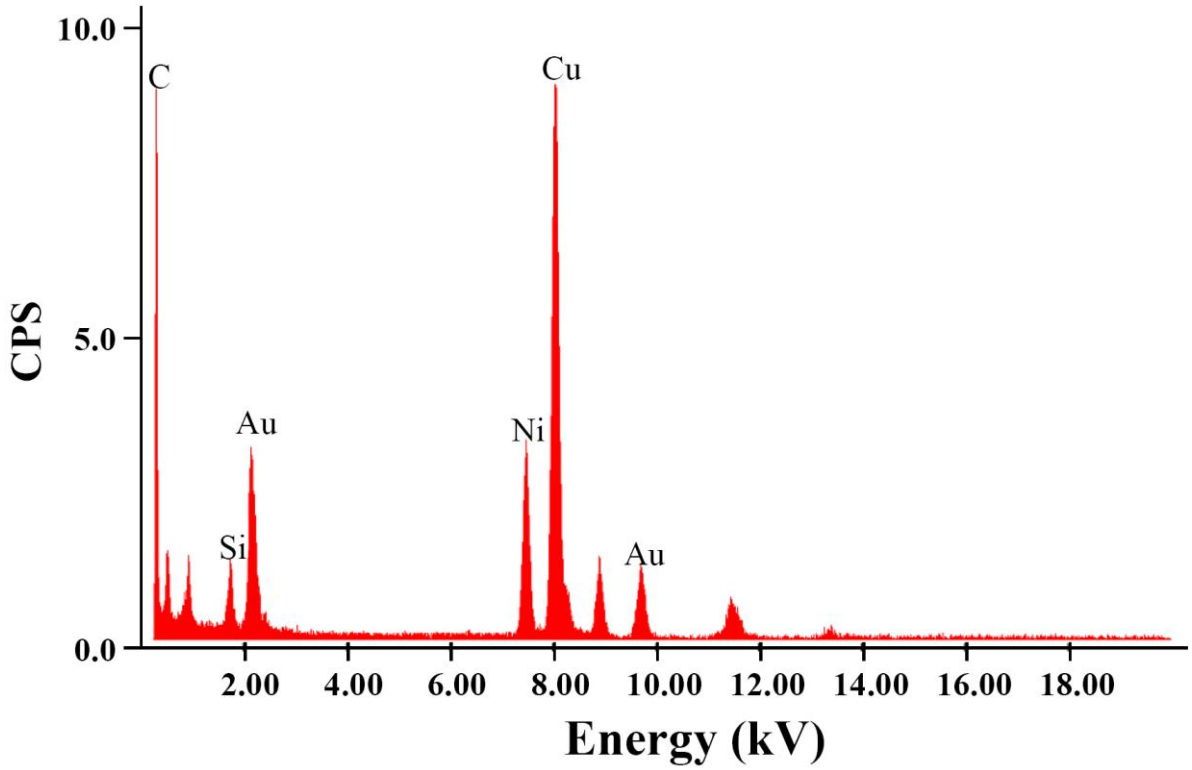

Fig. S3 EDS spectrum of the Au NPs indicating the presence of Cu atoms on the NPs. After Au NPs reacted with Cu^{2+}, Pb^{2+}, and 2-ME, the particles were purified and dipped on a carbon-coated nickel grid, and then dried at room temperature. Other conditions were the same as those described in Figure S2.

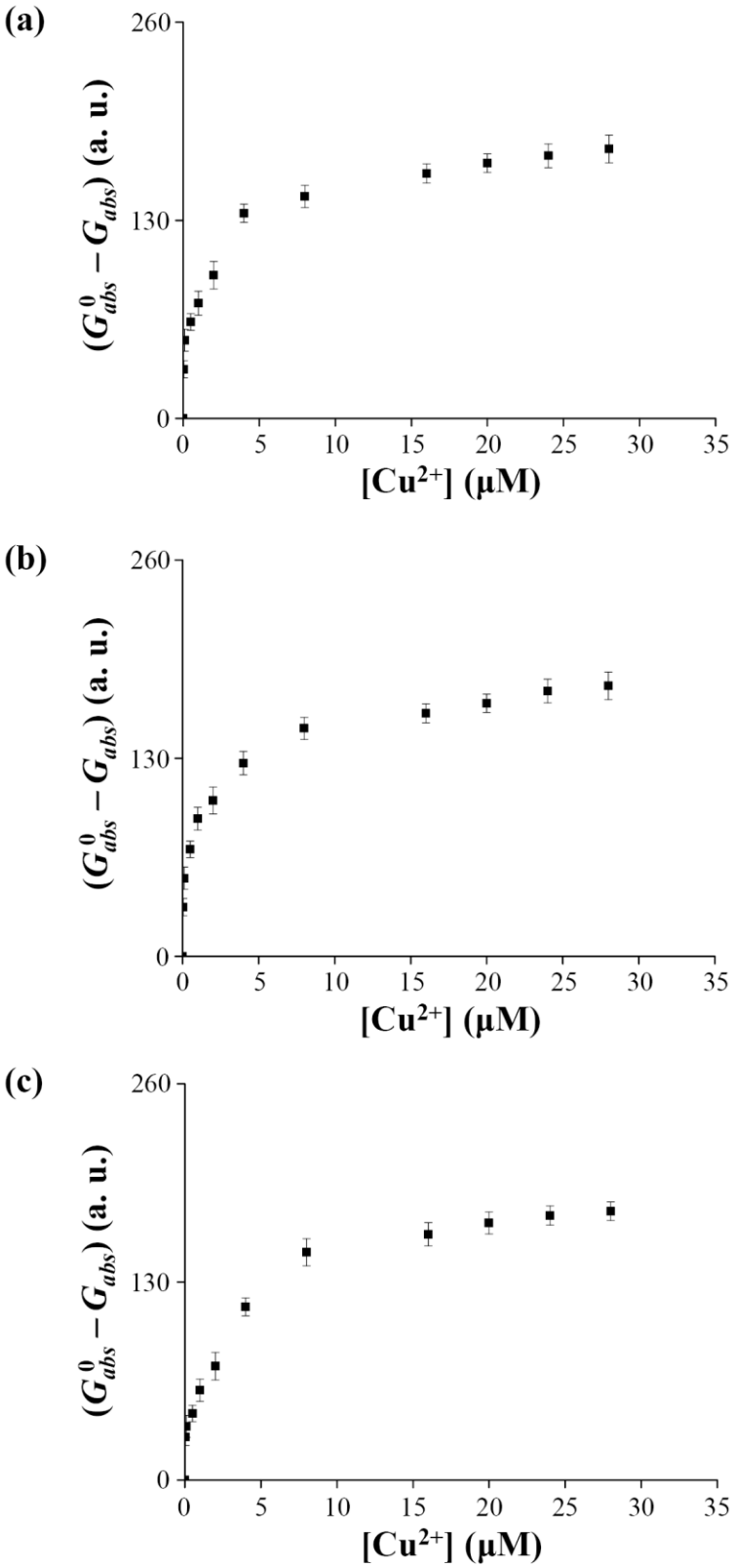

Fig. S4 Analyses of representative (a) stream water, (b) sea water, and (c) tap water samples using the Pb^{2+}/2-ME–BSA-Au NPs/NCM probes. Diluted water samples (2.5-fold) were spiked with Cu^{2+} ions (0–30 μM). Other conditions were the same as those described in Figure 5.

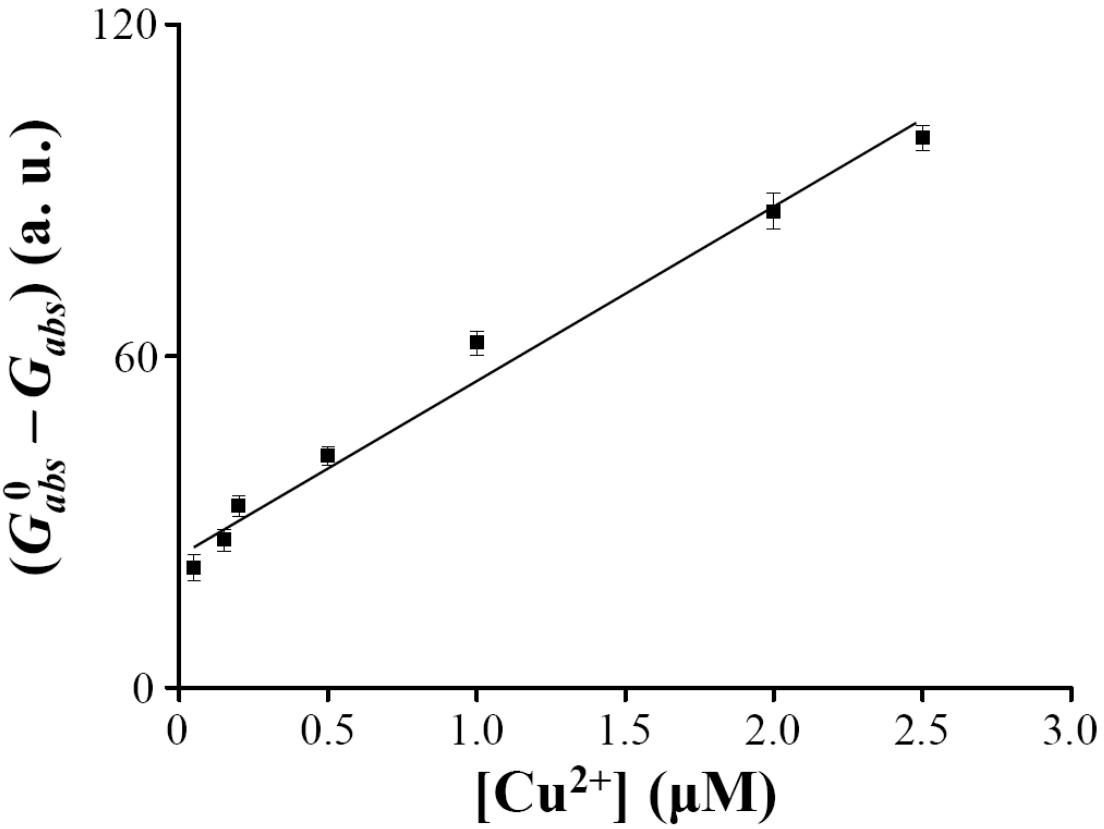

Fig. S5 Analyses of the copper concentration in blood samples using the Pb^{2+}/2-ME–BSA-Au NPs/NCM probes. The pretreated blood samples were spiked with Cu^{2+} ions at concentrations of 0–2.5 μM and then analyzed using the Pb^{2+}/2-ME–BSA-Au NPs/NCM probes. Other conditions were the same as those described in Figure 5.