Supporting information

Materials

Hydrogen tetrachloroaurate(III) ($HAuCl_4.4H_2O$, 99.99%) was purchased from China National Pharmaceutical Group Corporation and used as received. Thiolated oligonucleotides (5'-SH-TTTTTT-3', 5'-SH-TTTTTTTTTT-3', abbreviated as T6 and T10, respectively) were purchased from shanghai Sangon Biotechnology Co. (Shanghai, China). PDMS (Sylgard 184) was obtained from Dow corning (Midland, MI, USA). $Hg(NO_3)_2$ was obtained from Sigma. Deionized water was produced with a Milli-Q system. Au NPs (12±1 nm) were synthesized according to the traditional citrate-reduced method. Environmental water sample was taken from a nearby river and centrifuged to remove the insoluble impurities. Different concentrations of Hg^{2+} were spiked in the river water for the concentration-dependent experiments.

Modification of Au NPs with Mixed Monolayer of T6 and T10

The aqueous Au NPs solution, 5ml, and mixture of T6 and T10 (final concentrations of T6 and T10 are 2 μM and 3 μM, respectively) were incubated together for 16 h under constant stirring. The solution was slowly brought up to a final salt concentrations of 0.1 M NaCl and 10 mM phosphate (pH 7) and allowed to stand for 40 h. Centrifugation was performed for 40 min at 14,000 rpm to remove excess of reagents. The precipitate was washed with 0.1 M NaCl, 10 mM phosphate buffer (pH 7) solution, recentrifuged and finally redispersed in deionized water.

Preparation of PDMS microfluidic chips

Microfluidic chips with Y shape zigzag microchannels were fabricated with the well-established soft lithography process. Briefly, a negative master was fabricated on a silicon

wafer with SU-8 photoresist. After passivation of the master using a plasma etcher, PDMS was cast onto the master and then put in oven for 2h at 80 ^{o}C. The cured PDMS was peeled off from the master and through-holes for inlet reservoirs (d=1 mm) and waste reservoirs (d=2 mm) were punched using metal pipes with different diameter. The PDMS chip was reversibly bonded to a flak PDMS slab (3 mm thick) and dimensions of the microchannels in the microfluidic chip are 100 μm (width) × 30 μm (height). The dimensions of whole chip are 3.5 cm (width) × 5 cm (length).

Operation of the microfluidic chip

The microfluidic chip was placed in a vacuum desiccator and degassed at 10 kPa for 1 hour. Immediately after removal from the desiccator, the microfluidic chip was sealed with a piece of adhesive tape except the inlets reservoirs. 4 μl of mixture of Au NPs and $NaClO_4$ (0.6 M), and 4 μl of metal ions were dispensed into either inlet reservoir using micropipette, respectively.

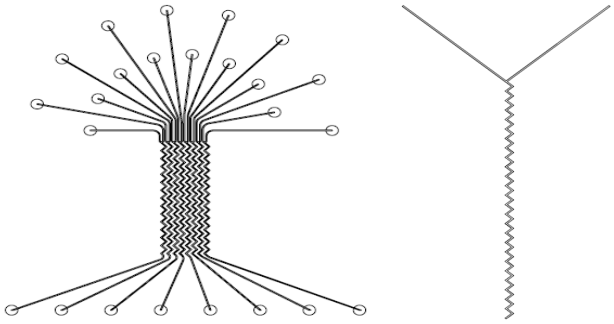

Figure S1. Left: Diagrams of the PDMS microfluidic channels. Right: Two-inlet layout of one channel.

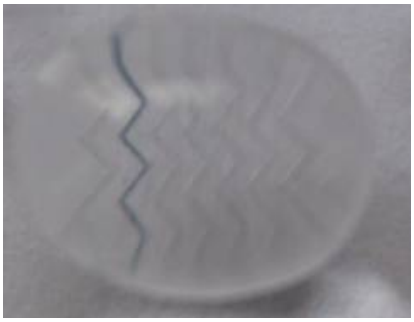

Figure S2. Naked-eye detection of Hg^{2+} with the help of a droplet of water cast on the channels that served as the "magnifying glass". The experimental conditions are detailed in Fig. 3A.