Supporting Information

A Label-free and Universal Platform for the Construction of Odd/Even Detector for Decimal Numbers Based on Graphene Oxide and DNA-stabilized Silver Nanoclusters

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Native polyacrylamide gel electrophoresis

Polyacrylamide gel (12%) was prepared with 1×Tris-borate-EDTA buffer (89 mM Tris, 89 mM boric acid, 2 mM EDTA, pH 8.3). Each sample was prepared with 1×Tris-borate-EDTA buffer containing 12 mM Mg^{2+}, and the concentration of each DNA strand was 4 μM. The sample solution was heated at 90 °C for 10 min and then annealed slowly to room temperature. 10 μL of each sample was mixed with 6 ×loading buffer (2 μL) before loading into the gel. The gel was run under a constant voltage of 140 V over a period of about 1 h. The gel was stained with 0.5 μg/mL ethidium bromide (EB) solution for 0.5 h and then washed with

pure water twice. Photographs were taken under UV light by using a fluorescence imaging system.

Human Serum Samples.

The human serum samples were diluted with reaction buffer 10 times prior to detection. Then, the target DNA was detected in these human serum samples following the same procedure. The condition of 10% human blood serum and the sodium phosphate buffer was from our previous literature[1] and other references[2, 3].

Bioimaging

Thyroid carcinoma cells (CGTHW-3) were cultured in growth medium supplemented with 10% FBS. Thyroid carcinoma cells were plated onto 35 mm glass chamber slides. The Ag-DNA encapsulated silver nanoclusters were prepared in PBS buffer (10 mM Na_2HPO_4/NaH_2PO_4, 100 mM CH_3COONa, 5 mM $Mg(CH_3COO)_2$, pH 7.5). The stock solution of silver nanoclusters was diluted by complete growth medium with 10% FBS and the final concentration was focused at 5 μM and 10 μM, respectively. Then the freshly prepared solution (5 μM and 10 μM silver nanoclusters) was placed over the cells for 2–3 h. All cells were washed with PBS buffer (3×) at room temperature. After that, cells were scanned by inverted fluorescence microscope (IX73, Olympus).

Cell viability assay

Cells were plated overnight on 96-well plates at 5000 cells per well in growth medium. After seeding, cells were maintained in growth media treated at increasing concentrations (1 μM, 2 μM, 5 μM, 10 μM) of AgNCs for 24 h. 20 μL of MTS (Promega Corp) solution (2 mg/mL) was added to each well for 2 h at 37 °C, and then the absorbance was measured on a SpectraMax 340 microplate reader (Molecular Devices, USA) at 490 nm with a reference at 690 nm. The optical density of the result in MTS assay was directly proportional to the number of viable cells. Each experiment was done in triplicate. The relative cell viability was recorded and shown in Fig. S4.

Table S1 DNA sequences used in this work

name	Base number	DNA sequences(from 5'-terminal to 3'terminal)
Ag-DNA	28	TAGTGACGTCCAGCATCCCCCCCCCCCC
N_0	14	GCTGGACGTCACTA
N_1	11	AATTATGTAAA
N_2	11	ATTAATAGAAT
N_3	11	TAATAATGAAT
N_4	11	TAAAATCATTA

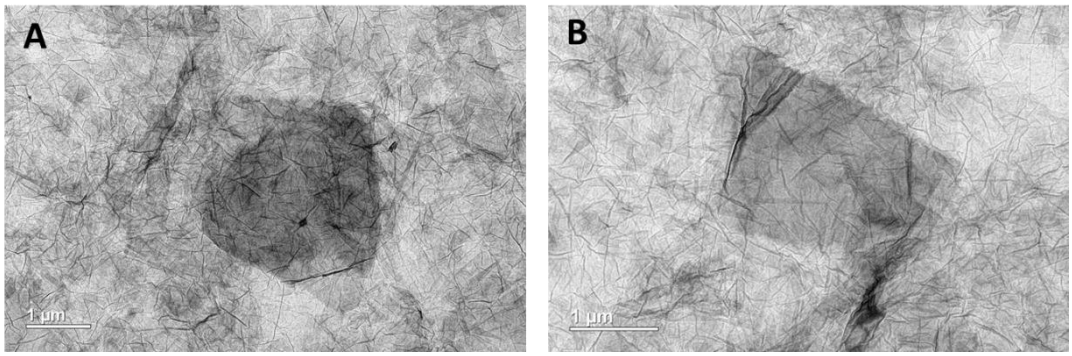

Fig. S1. Transmission electron micrograph (TEM) of graphene oxide.

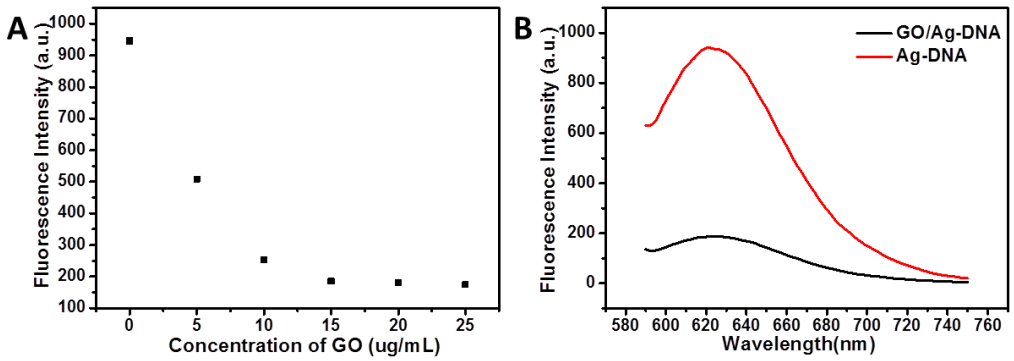

Fig. S2. (A) The AgNCs fluorescence response of Ag-DNA in the presence of different concentration of GO from 0 to 25 μg/mL. (B) Comparison of FAM fluorescence signal of Ag-DNA (100 nM) before and after addition of GO (15 μg/mL).

As shown in Fig. S2, The fluorescence intensity of AgNCs was significantly quenched and reached a plateau when the GO concentration increased to 15 μg/mL. So the GO concentration of 15 μg/mL was chose as the optimal condition.

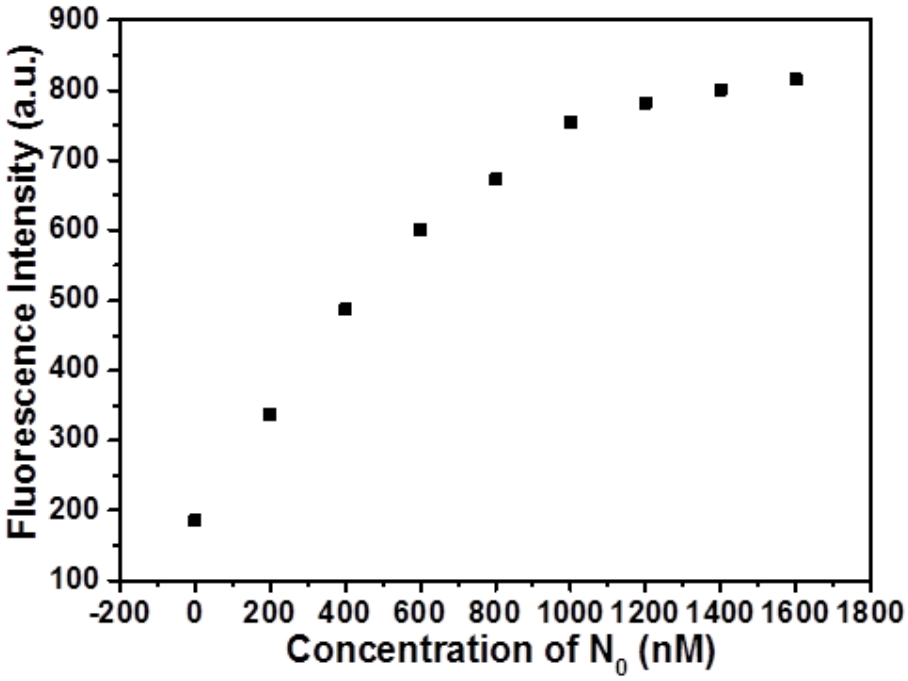

Fig. S3. The AgNCs fluorescence response of GO/Ag-DNA at 620 nm with increasing the concentration of N_0.

The AgNCs fluorescence of Ag-DNA was generally recovered and reaches a plateau with increasing the concentration of N_0. Here, 1 μM was used for each input.

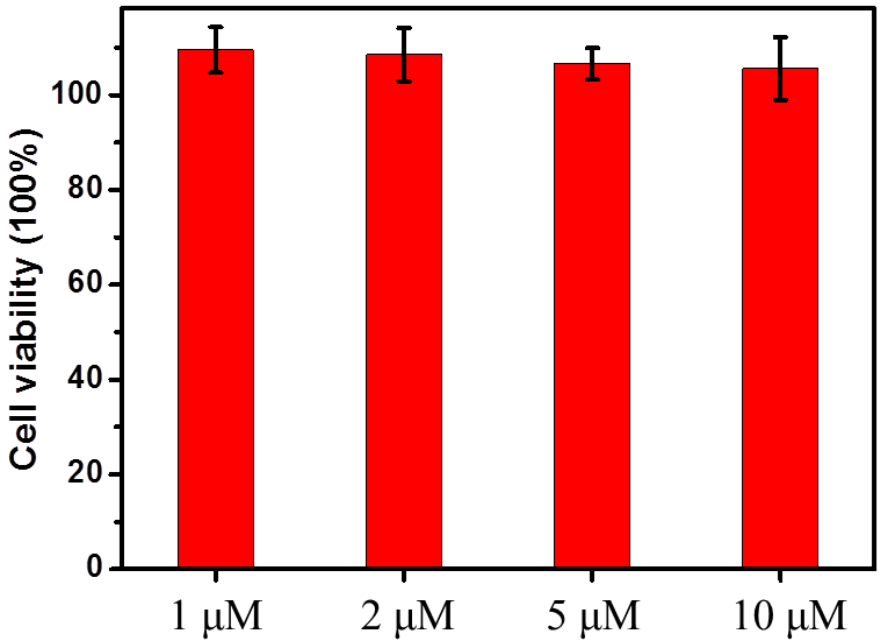

Fig. S4. Cell viability of CGTHW-3 in the presence of AgNCs with indicated concentration determined by MTS.

As shown in Fig.S4, in the presence of silver nanocluster, the cell viabilities for silver nanocluster do not decrease. The MTS assay suggests that the as-prepared AgNCs are not toxic to thyroid carcinoma cell.

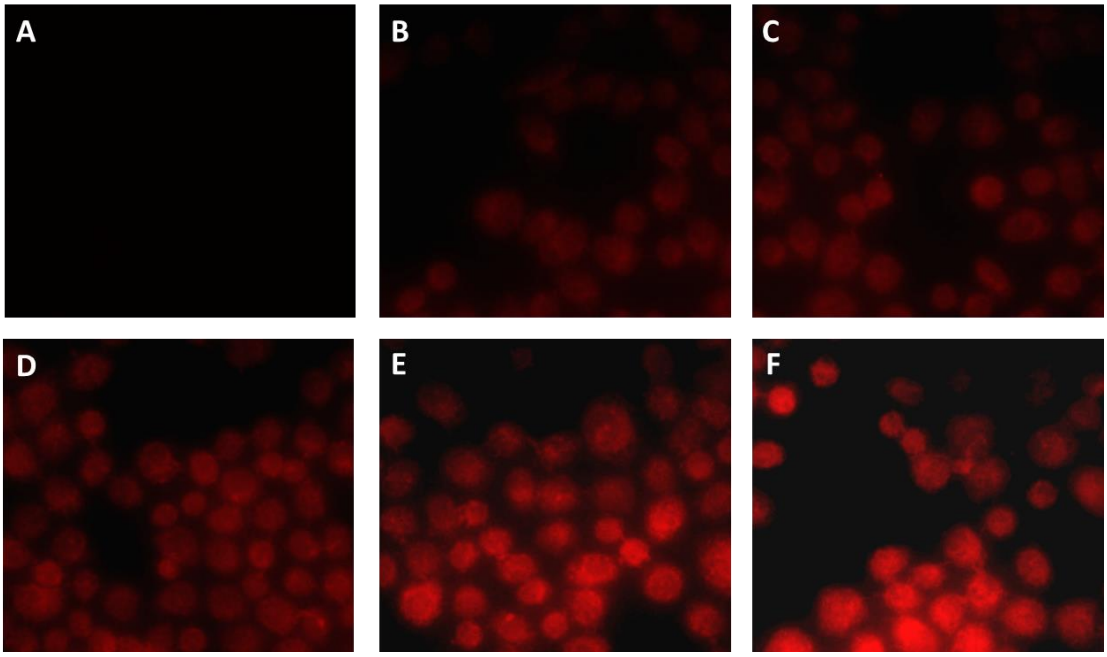

Fig. S5. Representative fluorescence images of the thyroid carcinoma cells (CGTHW-3) under different conditions: (A) incubated with 0 μM AgNCs; (B) incubated with 2 μM AgNCs; (C) incubated with 4 μM AgNCs; (D) incubated with 6 μM AgNCs; (E) incubated with 8 μM AgNCs; (F) incubated with 10 μM AgNCs

To determine the accuracy of the fluorescence signal enhancement with the increase of AgNCs, biofluorescence imaging under different conditions was used in this work. As shown in Fig. S5A, in the absence of AgNCs, the fluorescence image of cell cannot be observed. With the increasing concentration of AgNCs from 0 to 10 μM, the bright fluorescent spots gradually emerge and the fluorescence signals can be greatly enhanced in the system (Fig. S5A-F).

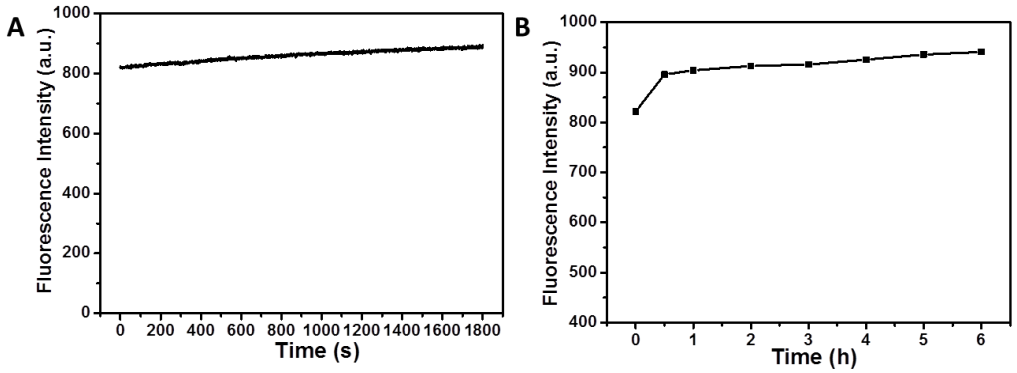

Fig. S6. Stability of DNA-AgNCs. The fluorescence intensity of 100 nM DNA-AgNCs (Ag-DNA plus N_0) at 620 nm was recorded for 0.5 h and 6 h with an excitation wavelength of 560 nm.

The stability of the AgNCs was characterized by fluorescence detection. As shown in Fig. S6, the AgNCs can keep the high intensity of fluorescence signal for 6 h in a given solution.

1. S. Zhang, K. Wang, K.-B. Li, W. Shi, W.-P. Jia, X. Chen, T. Sun and D.-M. Han, *Biosens. Bioelectron.*, 2017, **91**, 374-379.

2. K. He, Y. Li, B. Xiang, P. Zhao, Y. Hu, Y. Huang, W. Li, Z. Nie and S. Yao, *Chem. Sci.*, 2015, **6**, 3556-3564.

3. Q. Cao, Y. Teng, X. Yang, J. Wang and E. Wang, *Biosens. Bioelectron.*, 2015, **74**, 318-321.