Electronic Supplementary Material (ESI) for Lab on a Chip

Supporting Information (SI)

Visual and High-throughput Detection of Cancer Cells Using a Graphene Oxide-based FRET Aptasensing Microfluidic Chip

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SI-1

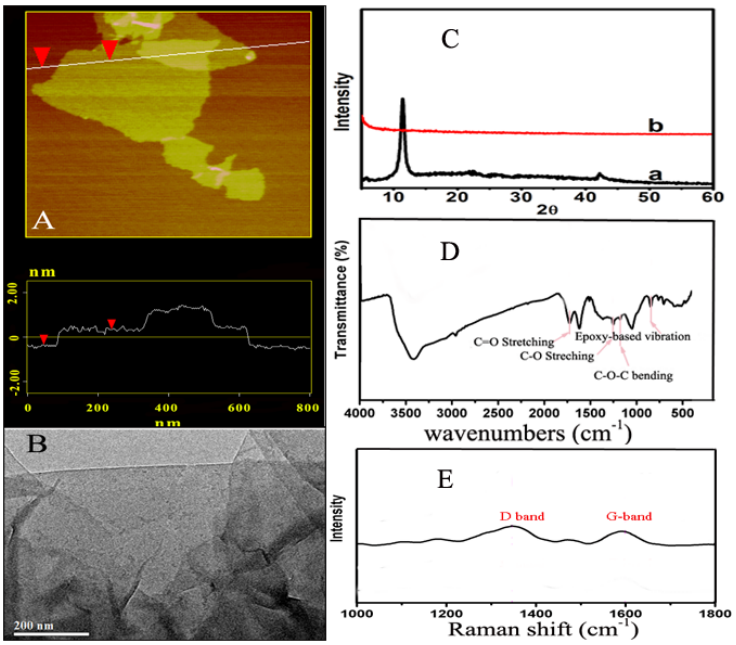

Fig. S1 Characterization of GO. (A) AFM image and depth profiles of as-prepared single layer GO. (B) High resolution TEM image of GO. (C) XRD Patterns of graphite oxide (a) and GO (b). (D) IR and (E) Ramanspectra of GO.

Synthesis and Characterization of GO

Single-layer nanosheet GO was prepared from exfoliation of graphite oxide, and was readily dispersible in water due to the presence of suspended hydroxyl and carboxylic groups at the surface. Firstly, to verify the nanosheet structure of the as-prepared GO, AFM, TEM and XRD characterization were employed. AFM images (Fig. S1A) show that the thickness of GO was about 0.7 ± 0.2 nm, indicating its single-layer. TEM image of GO (Fig. S1B) shows that the nanosheet was extremely thin and highly transparent. The XRD pattern shows that the graphite oxide (Fig. S1C-a) had a characteristic (002) peak position, implying that it processed a typical layered structure, whereas there were not any diffraction peaks for GO nanosheets (Fig. S1C-b), which also implies that the single layer of GO is formed through exfoliation[1]. Secondly, in order to explain its well-solubility of GO, we characterized the GO samples with IR and Raman spectra to determine its composition. The IR spectrum of GO (Fig. S1D) shows that GO nanosheets had characteristic C=O stretching (1731 cm^{-1}), C-O stretching (1264 cm^{-1}), C-O-C bending (1186 cm^{-1}), and epoxy base (841 cm^{-1}) vibrations, demonstrating the presence of $–COO^-$ groups. Raman spectrum (Fig. S1E) shows that GO nanosheets exhibited two characteristic main peaks at 1365 cm^{-1} and 1594 cm^{-1}, which could be ascribed to the D and G bands of graphene (the symmetry A1g mode and the E2g mode of sp2 carbon atoms, respectively)[2]. Therefore, the as-prepared GO nanosheets with well dispersion in water (1.0 mg/mL) make it suitable as an efficient quencher of FRET biosensors.

SI-2

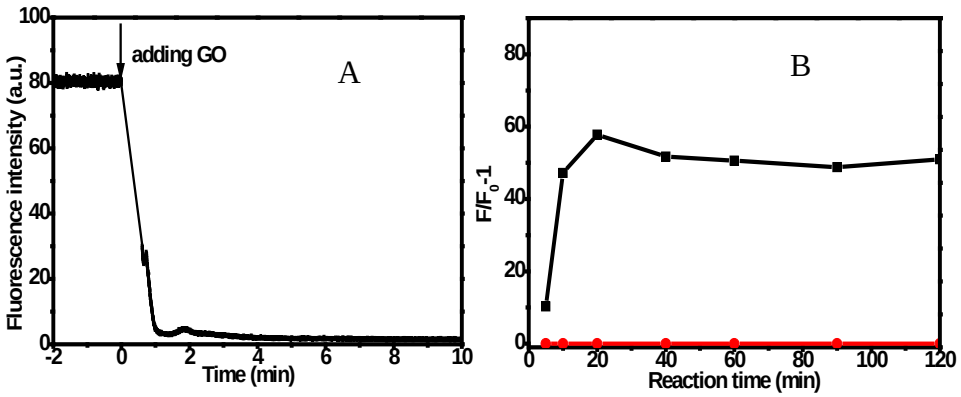

Fig. S2. The fluorescence kinetic study of (A) FAM-Sgc8 and GO, and (B) GO/FAM-Sgc8 and CCRF-CEM cells. (A) The fluorescence quenching of FAM-Sgc8 by GO versus time. (B) The fluorescence recovery of GO/FAM-Sgc8 induced by CCRF-CEM cells versus time. The black and red lines represented the addition of CCRF-CEM cells or not, respectively. FAM-Sgc8 concentration: 25 nM. GO concentration: 6.0 μg/mL. CCRF-CEM cells concentration: 2.5×10^6 cells/mL. Excitation wavelength: 488 nm. Emission wavelength: 520 nm.

Fluorescence Kinetic Study

The kinetic behaviors of GO/FAM-Sgc8 with CCRF-CEM cells were fully investigated by monitoring the relative changes of fluorescent intensity via time. Here, the relative fluorescence changes were calculated by $(F/F_0\text{-}1)$, where F_0 and F were the fluorescent intensity of GO/FAM-Sgc8 and GO/FAM-Sgc8@CCRF-CEM cells, respectively. The fast quenching process of FAM-Sgc8 by GO was obtained (Figure S2A, in 2 min), but the fluorescence recovery of the GO-based aptasensor induced by CCRF-CEM cells was relatively slow (Figure S2B), where the fluorescence intensity attained a plateau when the incubation time was longer than 20 min. Thus, in order to gain the maximum signal readout of the GO/FAM-Sgc8 aptasensor for CCRF-CEM cells, 20 min was chosen as the ideal incubation time for all the detection.

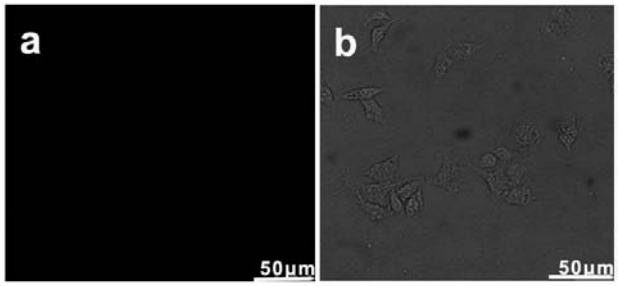

Fig. S3 The confocal fluorescence (a) and transmission (b) images of HeLa cells (as the control cell) incubated with GO/FAM-Sgc8. Scale bar: 50 μm. Excitation wavelength: 488 nm. Emission wavelength: 520 nm.

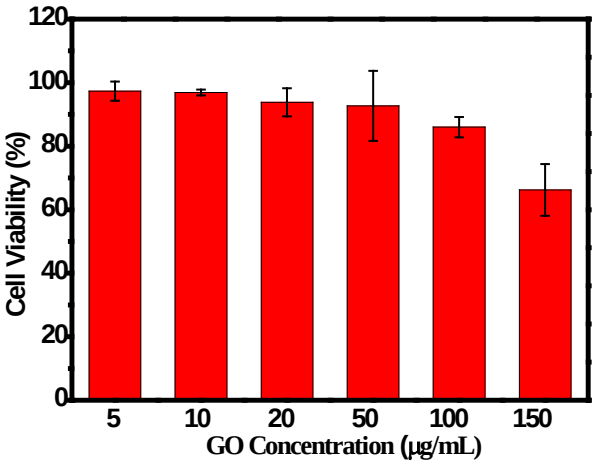

Fig. S4 Cell viability at different GO concentrations (5, 10, 20, 50, 100, and 150 μg/mL). Wavelength: 450 nm. The percent cell viability is calculated relative to that of the cells without the added GO, which are defined to have a viability of 100%.

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Notes and references

1. K. H. Liao, Y. S. Lin, C. W. Macosko and C. L. Haynes, *Appl. Mater. Interfaces*, 2011, **3**, 2607-2615.
2. J. Lee, S. Shim, B. Kim and H. S. Shin, *Chem. Eur. J.*, 2011, **17**, 2381 – 2387.