Supplementary Material (ESI) for Chemical Communications

SUPPORTING INFORMATION

Single-walled carbon nanotubes chemiresistor aptasensor for small molecules: Picomolar level detection of adenosine triphosphate

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1. Aptasensor Fabrication:

Device fabrication protocol followed in this work was adapted from procedure described previously.[1] A uniformly dispersed and separated SWNTs suspension was prepared by ultrasonication (power level 9) and centrifugation (10,000 rpm) a 25 µg SWNTs (high carboxylated functionality, sold under the trade name of P3-SWNT, were purchased from Carbon Solutions, Inc. Riverside, CA, USA) in 1 mL DMF for three different times (90, 60, 30 min for each cycle). A 0.1 µL drop of the dispersed SWNTs was dispensed between the gap (3 µm) of a pair of microfabricated gold electrodes and aligned by AC dielectrophoresis (DEP) by applying a 4 MHz (amplitude 0.366V p-p) AC field across the electrodes for a few seconds using a function generator (Wavetek, Alpharetta, GA, USA) and then annealed at 300 ^{o}C for an hour under a continuous flow of 5% H_2 plus 95% nitrogen gas to evaporate residual DMF and reduce the contact resistance between the carbon nanotubes and the gold electrodes. The SWNTs interconnects/channel of the chemiresistor was then incubated with 6 mM 1-pyrenebutanoic acid succinimidyl ester (PBASE) in DMF for 1 h followed by thorough washing with DMF to remove residual esters. The capture oligonucleotides were covalently attached to the PBASE-modified SWNTs by incubating overnight at 4 ^{o}C 200 nM oligo (5'-/5AmMC6/TGT GAC ACC TTC CC-3') or aptamer (5'-ACC TGG GGG AGT ATT GCG GAG GAA GGT GTC ACA-3' for the traditional format) in 10 mM pH 7.2 phosphate buffer (PB) through the amide bond between the amine at its 5' end and N-hydrosuccinimide ester of PBASE washed three times with PB to remove excess oligos followed by treatment with 0.1 mM ethanolamine for 30 min at room temperature to block excessive reactive groups and finally by incubation with 0.1% Tween 20 to prevent nonspecific binding. The capture oligos were subsequently hybridized to aptamers by incubating with a 200 nM aptamer solution in PB heated at 65^{0}C for 5 min, then for 2 h at room temperature and washed with PB 3 times to remove excess aptamers.

2. Sensing measurements

The sensing protocol consisted of monitoring the initial resistance (R_0) of the aptasensor fabricated above by measuring the source-drain current (I) as a function of source-drain voltage (V) from -0.5 V to +0.5 V using a HP 4155A (Agilent, Santa Clara, CA, USA) semiconductor parameter analyzer and taking the inverse of the slope of the I-V curve from -0.1 V to +0.1 V followed by incubation for 10 min at room temperature with different concentrations of ATP in 10 µl PB, washing three times with PB, and recording the new resistance under wet conditions in presence of PB. Figures S1(A) and S1(B) show the I-V curves for SWNTs-based aptasensor at various stages of fabrication and after incubation with different ATP concentrations, respectively.

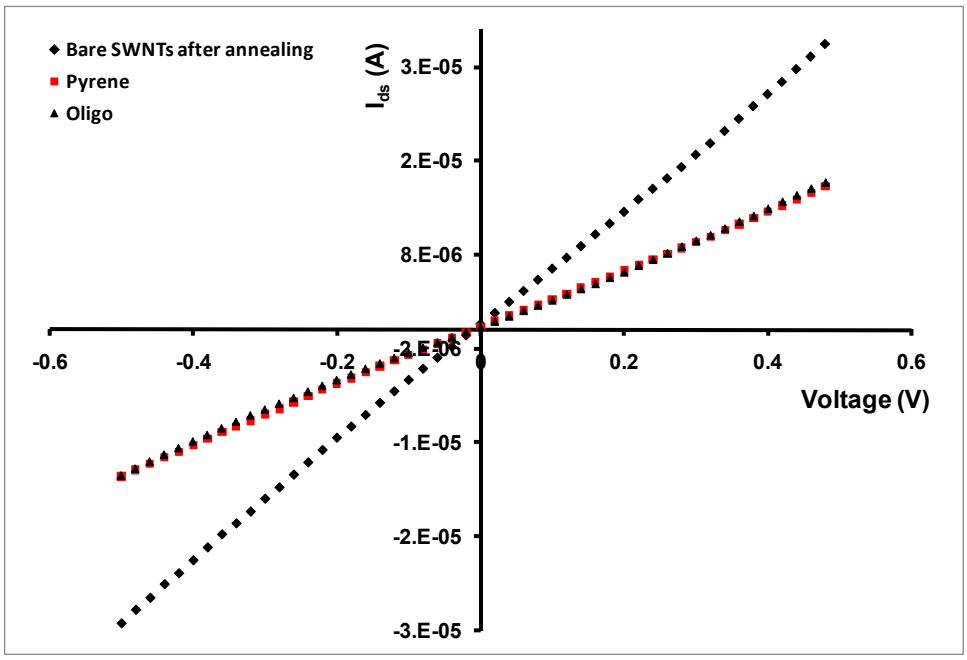

Figure S1(A). I-V curves for SWNTs after annealing, after PBASE and after oligo functionalization.

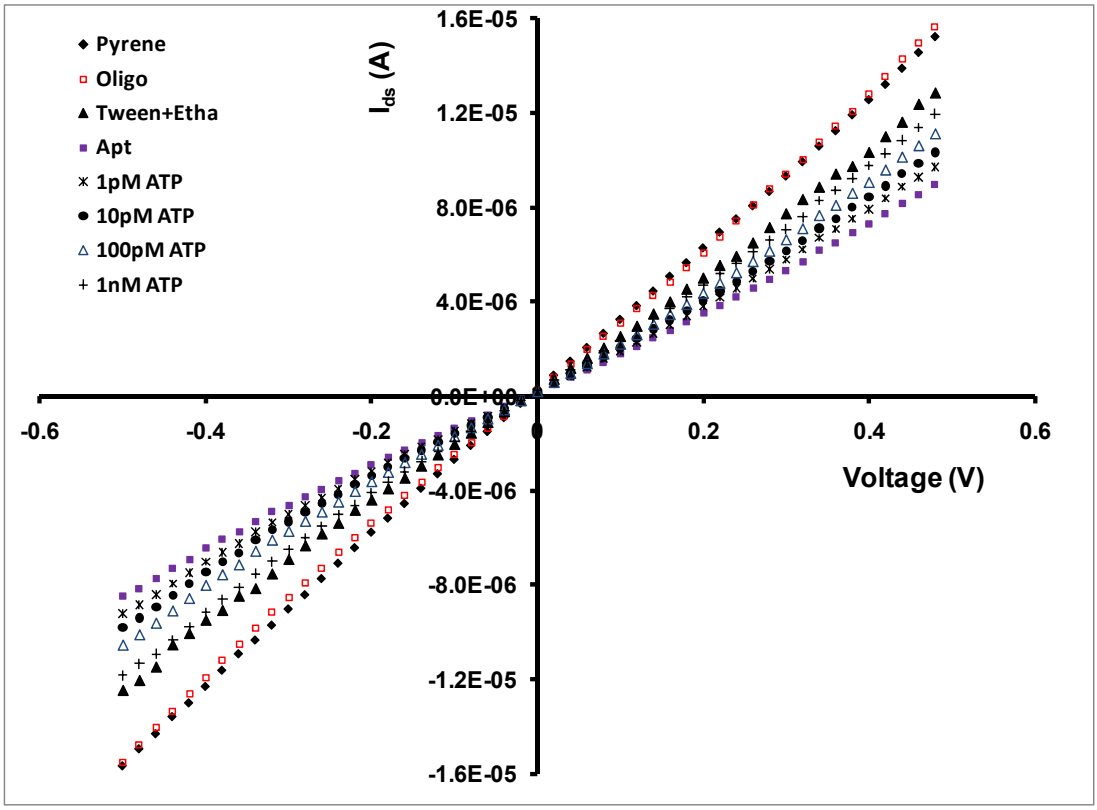

Figure S1(B). I-V curves of aptasensor to 1 pM, 10 pM, 100 pM and 1 nM ATP.

1. L. N. Cella, P. Sanchez, W. Zhong, N. V. Myung, W. Chen and A. Mulchandani, *Anal. Chem.* 2010, **82**, 2042-2047.