† Electronic Supplementary Information (ESI) available:

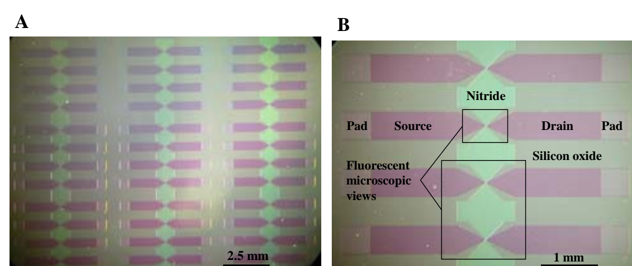

Fig. S1 Optical images of poly-SiNW FET. (A) Camera view of fabricated device on silicon wafer. (B) A microscopic view of four sets of poly-SiNW FET device. The source and drain pads were connected to tungsten probe needles to measure the electronic properties at room temperature using three probe contact geometries. The two squares indicate the parts of the fluorescence images shown in Fig. 2 and Fig. S3, respectively.

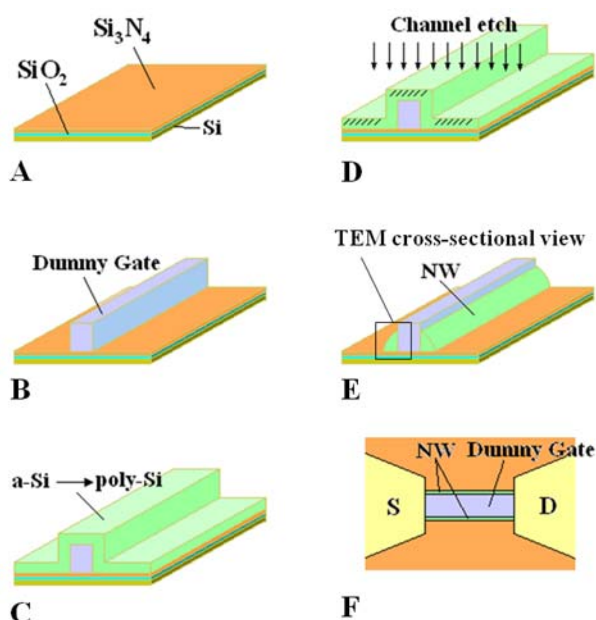

Fig. S2 Schematic diagrams for the fabrication of poly-SiNW FET. (A) A 6-inch Si wafer capped with a 100 nm SiO_2 layer and a 50 nm Si_3N_4 layer. (B) Dummy gates made of SiO_2 were formed on the substrate. (C) A 100 nm a-Si layer was deposited by low-pressure chemical vapor deposition (LPCVD). Afterward an annealing step was performed at 600 °C in nitrogen ambient for 24 hrs to transform the a-Si into poly-Si. (D) Source/drain (S/D) implant was performed. Note that the implant energy was kept low (15 keV) so the portions of Si layer at the sidewall of the dummy gate remained undoped. (E) After a lithographic step to generate S/D photoresist patterns (see (F)), an anisotropic plasma etch step was used to define the S/D regions. The sidewall Si nanowire channels were formed simultaneously in this step. All devices were then passivated by a 300 nm-thick TEOS oxide deposited by LPCVD and the S/D dopants were activated with an annealing treatment. The fabrication was completed after exposing the nanowire channels and formation of the test pads using lift-off metallization steps. (F) Top view of the fabricated device structure with fan-out source/drain patterns. It SEM image is shown in Fig. 1.

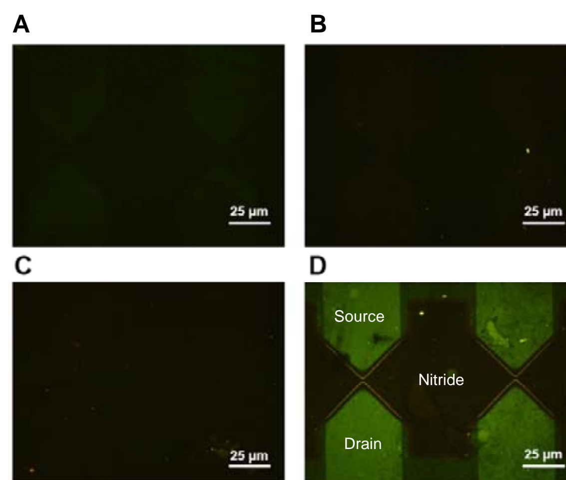

Fig. S3 Fluorescent microscopic image of the functionalized poly-SiNW FET device following reaction with dye ARS. The relative position of the device is illustrated in Fig. S1. The control experiments were performed where the NWs were not complete with functionalization. (A) Unmodified poly-SiNW FET, (B) APTES modified, and (C) CPBA+EDC modified poly-SiNW FET gave no fluorescent light upon addition of ARS under blue light excitation. Only the completely functionalized device (D) gave the expected fluorescent light upon addition of ARS under blue light excitation except nitride layer, because only the surface of silicon oxide could be modified with APTES.

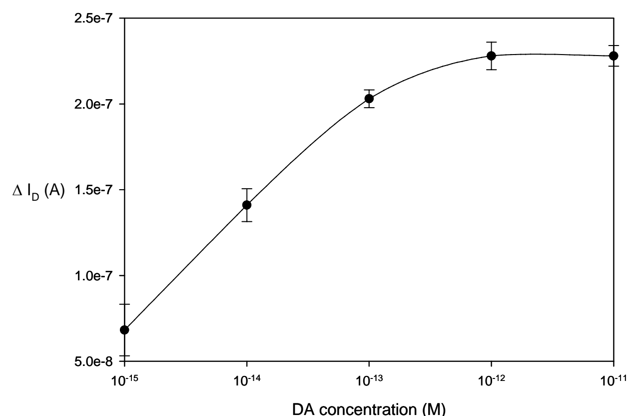

Fig. S4 The current changes (ΔI_D) of functionalized poly-SiNW FET with different DA concentrations. Drain current change was determined in fixed gate voltage (0.9 V). The current obtained in MES buffer was used as background current. ΔI_D was increased with increasing concentration of DA molecule and saturated at 1 pM. The reaction condition is described in Fig. 3. Each data was the average of three measurements.

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