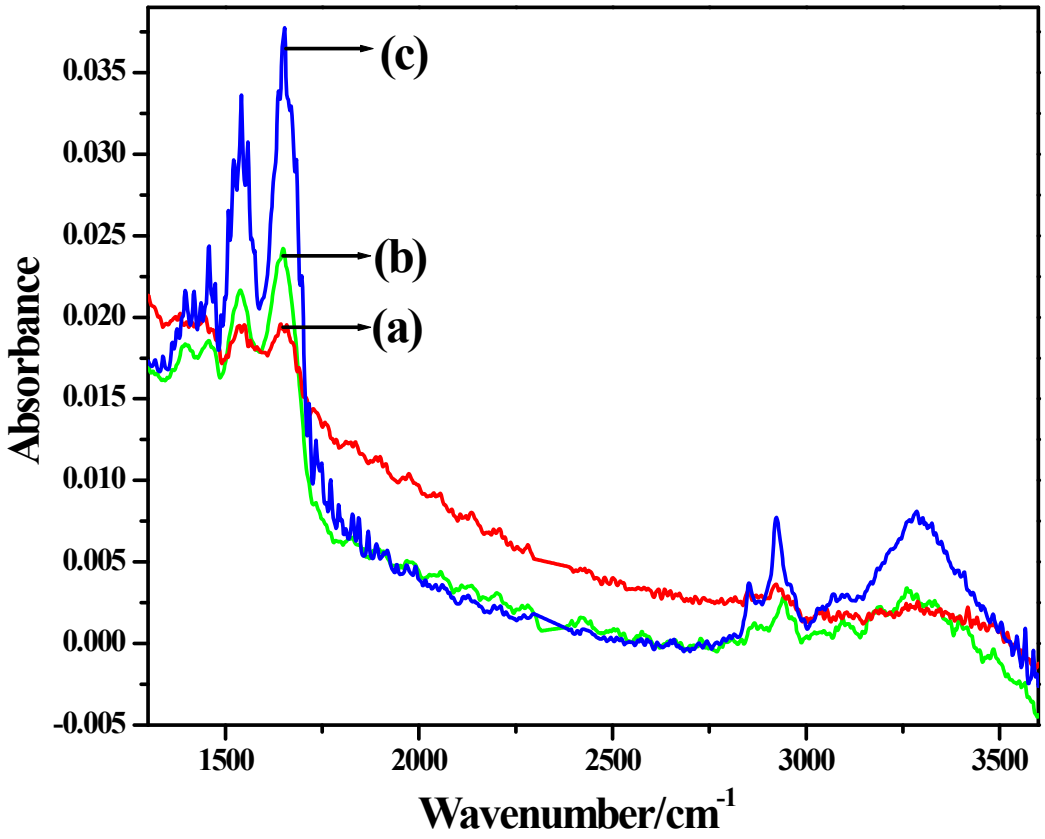
Supplementary Data

1. Structural characterization - Fourier transform infrared (FT-IR)

Supplementary Fig. 1 shows the FT-IR spectra of (a) PDDA, (b) PDDA-SWCNT, and (c) PDDA-SWCNT-Avidin-biotinylated antibody. Spectrum a shows the characteristic absorption bands of PDDA such as the CH_2 asymmetrical and symmetrical stretching frequencies at 2927 cm^{-1} and C=C stretching vibrations at 1639 and 1469 cm^{-1}.[1]

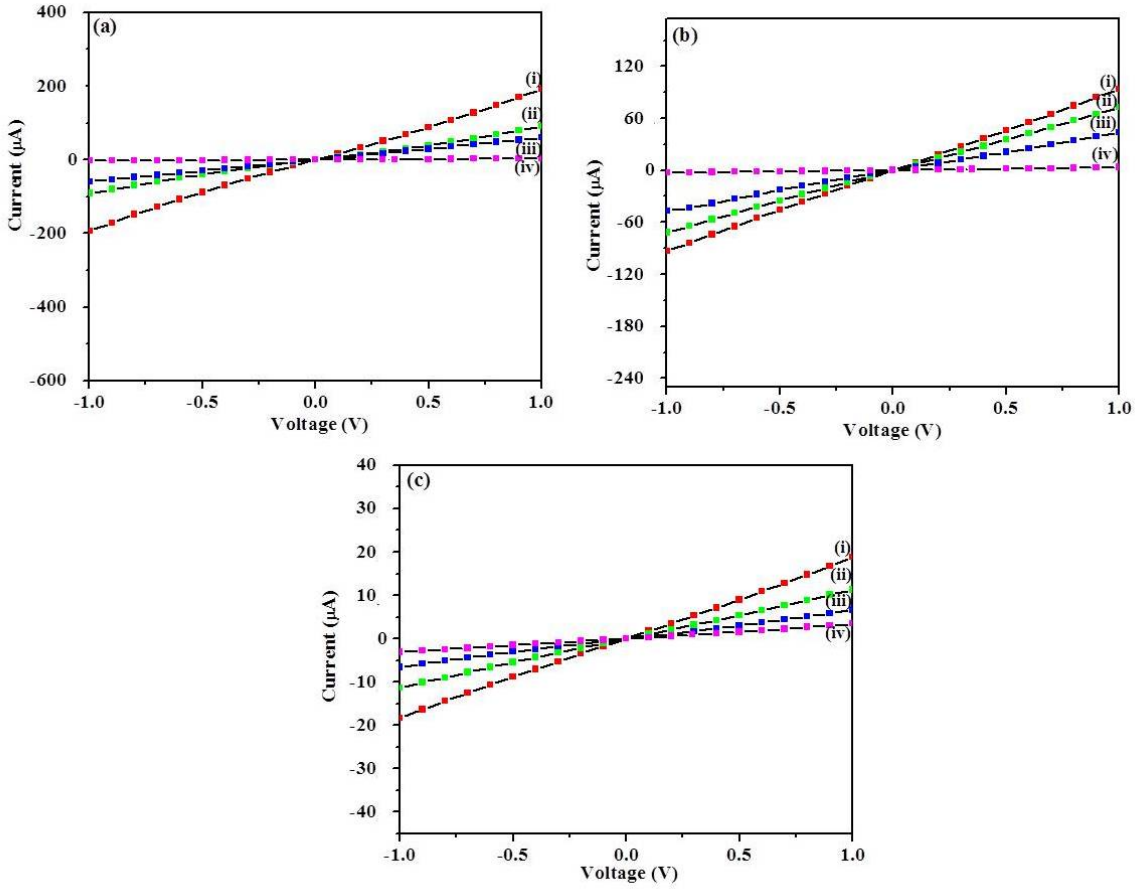


Supplementary Fig. 1 FT-IR spectra of (a) PDDA, (b) PDDA-SWCNT, and (c) H1N1 antibody immobilized PDDA-SWCNT.

There is a corresponding increase in the peak of 1639 cm^{-1} along with an intensity decrease of the peaks at 1469 cm^{-1}, and the decreased peaks are attributed to carbon-carbon double bonds indicating PDDA-SWCNT layer formation (spectrum b).[2] Spectrum c shows the antibody immobilization onto the avidin functionalized SWCNT surface, and the bands at 1665 and 1545 cm^{-1} exhibited due to the primary amide and secondary amide linkages. The band at 3282 cm^{-1} is associated with the combination of the amide and amine N-N frequencies and corresponds to N-H stretching vibrations.[3]

2. I-V measurements for various channel lengths

The current-voltage (I–V) measurements for the SWCNT immunosensors were performed in the voltage range from −1.0 to +1.0V. Supplementary Fig. 2 shows the I-V characteristic graphs of the SWCNT immunosensors with various channel lengths of (a) 2 μm, (b) 5 μm, and (c) 10 μm and a constant width of 100 μm for cases of (i) PDDA-SWCNT, (ii) PDDA-SWCNT-Avidin, (iii) PDDA-SWCNT-Avidin-biotinylated antibody, and (iv) PDDA-SWCNT-Avidin-biotinylated antibody-influenza virus. The measurements showed high linearity between current and voltage,[4] implying an ohmic contact between the SWCNT channel and gold electrodes as well as among the SWCNTs. The functionalization of PDDA-SWCNT with avidin, biotinylated antibody, and influenza viruses increased the channel resistance, indicating successful immobilization.



Supplementary Fig. 2 I-V characteristic graphs of the SWCNT immunosensor with various channel lengths (a) 2 μm, (b) 5 μm, and (c) 10 μm with constant width of 100 μm (i) PDDA-SWCNT, (ii) PDDA-SWCNT-Avidin, (iii) PDDA-SWCNT-Avidin-biotinylated antibody, and (iv) PDDA-SWCNT-Avidin-biotinylated antibody-H1N1 virus.

References

1. M. Huang, X. Xu, H. Yang and S. Liu, *RSC Adv.,* 2012, 2, 12844–12850.

2. D.Q. Yang, J.F. Rochette and E. Sacher, *J. Phys. Chem. B,* 2005, **109**, 4481–4484.

3. X. Cui, R. Pei, Z. Wang, F. Yang, Y. Ma, S. Dong and X. Yang, *Biosens. Bioelectron.,* 2003, **18,** 59-67.

4. W. Xue and P. Li, 2011, ISBN: 978-953-307-497-9.