Electronic Supplementary Material (ESI) for Analyst.

Construction of Carbon Nanotube Based Nanoarchitectures for Selective Impedimetric Detection of Cancer Cells in Whole Blood

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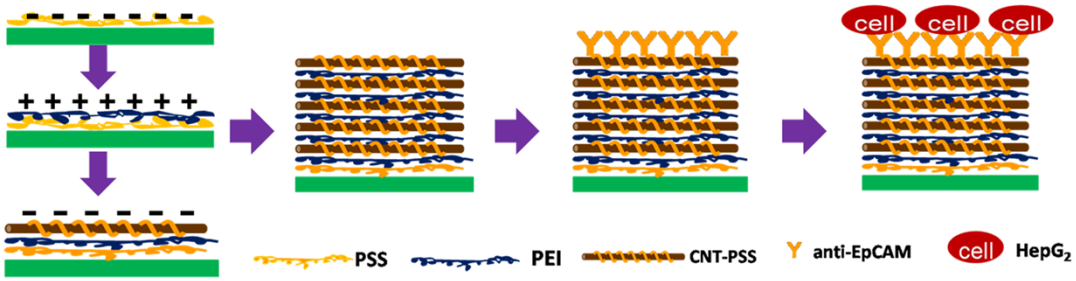

Scheme S1. Preparation of ITO/MWCNT/PEI/anti-EpCAM and immunological recognition between anti-EpCAM and $HepG_2$.

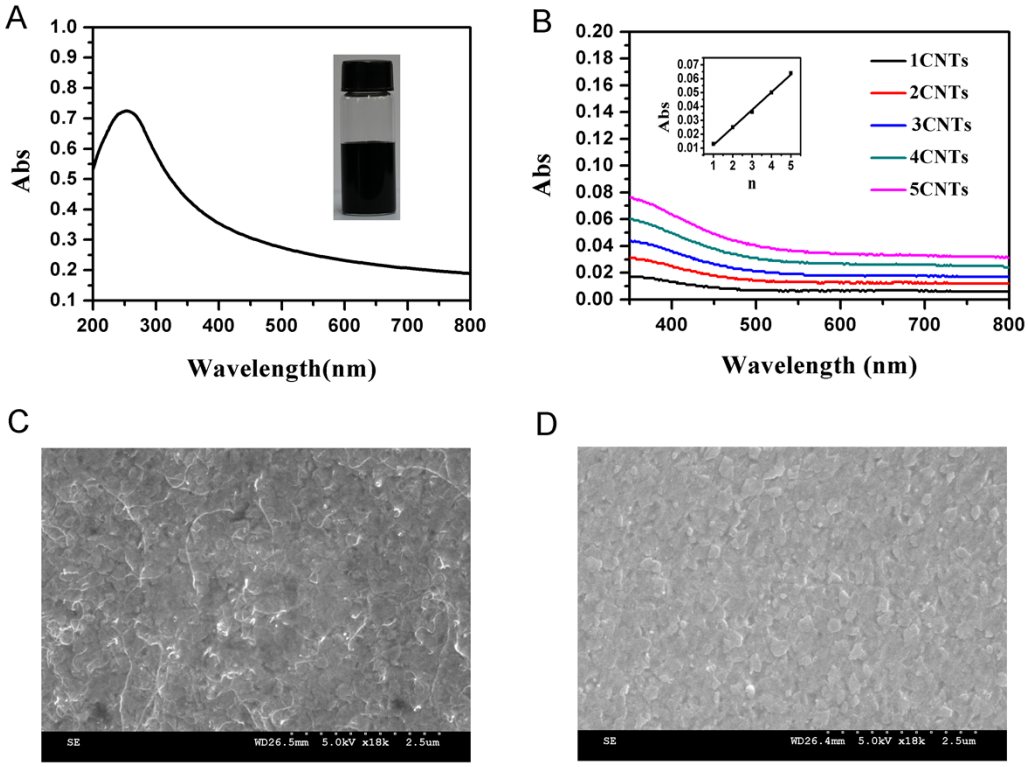

Fig. S1 (A) Absorption spectra of MWCNTs. Inset: Image of MWCNTs dispersed in PSS. (B) UV-vis spectra of $(MWCNT/PEI)_n$ multilayers assembled onto ITO surface. The inset shows the linear relationship between the absorbance at 400 nm and the MWCNT/PEI bilayer numbers. (C) TEM image of $(MWCNT/PEI)_5$ multilayers assembled onto ITO electrode. (D) TEM image of bare ITO electrode. Scale bar is 2.5 μm.

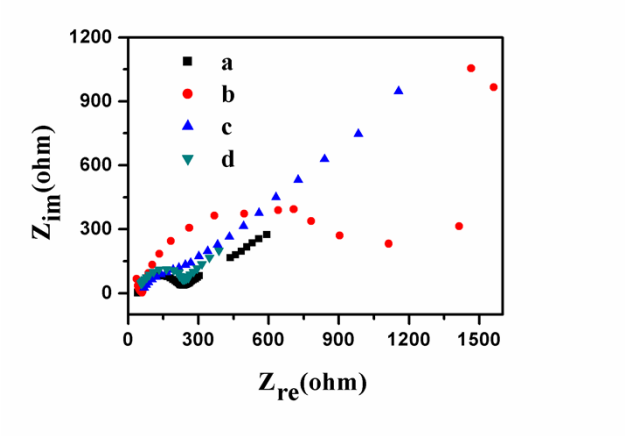

Figure S2 Nyquist plots of the prepared biosensors after incubation with PBS solution (a), the fetal bovine serum (b), healthy people serum (c) and whole blood from healthy people (d).

Table S1 Comparison of the proposed biosensor and other CTC sensors.

Detection method	LOD	Detection time	Linear range	Comment	Reference
Cyclic Voltammetry	1×10^5 cells mL^{-1}	15 min.	1×10^5 -1×10^8 cells mL^{-1}	A succinimidyl6-(3-[2-pyridyldithio]-propionamido) hexanoate (LC-SPDP) self-assembled monolayer prepared onto gold microelectrode(Au) surface has been utilized for covalent immobilization of anti-EpCAM antibody. Cancer cell identification via molecular profiling of cells on microelectrodes using ferrocene amidopentyl carboxylic acid based redox tagging and magnetic beads based enhancement was achieved by CV investigation in PBS.	S1
Cyclic Voltammetry	4.41×10^3 cells mL^{-1}	30 min.	1×10^3 - 5×10^4 cells mL^{-1}	By combining the capturing capability of anti-EpCAM antibody functionalized Au nanoparticles with the electrocatalytic properties of Au nanoparticles towards the hydrogen evolution reaction, selective detection of Caco2 cells was achieved.	S2
Electrochemical impedance spectroscopy	20 cells mL^{-1}	—	—	A semi-integrated electrical biosensor for the detection of rare CTCs in blood is described. The sample was first enriched through a combination of immunomagnetic isolation and size filtration. The sample was then transferred to a microchip for further magnetic concentration, followed by immunochemical trapping and electronic detection by impedance spectroscopy.	S3
Chemiluminescence	10^4 cells mL^{-1}	10 min.	2×10^4 -5×10^5 cells mL^{-1}	An aptamer-based “sandwich” approach combined with the chemiluminescence (CL) analysis was developed for the capture and detection of rare cells on a microfluidic chip. The capture efficiency for Ramos cells was more than 70% with the purity greater than 97%, when the content of the target cells was between 0.5% and 10% in the initial cell mixture.	S4
Magnetoresistance	a single cell	—	—	3D rolled-up structures made of a SiO_2 layer and a fishbone-like magnetic thin film were designed to attract and trap a magnetic cell to the sensor area for magnetoresistance measurement.	S5
Resonance frequency	~1 cell/10 mL	—		Resonance frequency shifts induced by mass-amplifying gold nanoparticles was used to detect prostate cancer. This approach has many advantages, including high specificity, sensitivity, and lack of need for amplification steps.	S6
	0-13 cell			A new system was developed for selective and sensitive detection of CTCs by	

	mL^{-1}			combining PCR amplification and signals amplification of cationic conjugated polymers.	
Digital-direct-RT-PCR	5 cells	—		The Digital-Direct-RT-PCR (DD-RT-PCR) combines Ficoll-separation, ThinPrep-fixation and one-step RT-PCR in a low-throughput digital-PCR format enabling the direct analysis and detection of individual CTC without RNA isolation.	S8
Multiplex PCR	10 cells	—		A multiplex PCR-based method was developed for detection of circulating tumor cells in peripheral blood of Lung Cancer using CK19, PTHrP, and LUNX specific primers.	S9
Microfluidic surface acoustic wave(SAM) sensor system	50 cells mL^{-1}	real-time		A nanostructured chip surface was fabricated enabling binding via spaced antibodies specifically targeting surface proteins of cancer cells and detection of extremely low numbers of CTC without labeling using a sam®5 biosensor.	S10
The proposed method	10 cells / mL	45 min	10 -10^5 cells mL^{-1}	The sensor is constructed with an ordered arrangement of carbon nanotubes (CNTs) and EpCAM antibodies, which are assembled on indium tin oxide (ITO) electrode surface. The tumor cells bind to EpCAM antibodies cause increase of the electron-transfer resistance.	in this study

Reference

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