Carbon nanotubes based microfluidic system for microparticle separation and sensing applications

A. *Mathur*, E. Hamad, S. S. Roy* and J. A. McLaughlin

Nanotechnology and Integrated Bio-Engineering Centre, School of Engineering,

University of Ulster, Newtownabbey, BT37 0QB, UK

Corresponding author: s.sinha-roy@ulster.ac.uk

There is a huge demand for new cost-effective microfluidic devices for bio-analysis. The reduction of size in the BioMEMS has the advantage as lesser reagents and smaller sample volumes are required and simultaneously open the door for rapid clinical diagnostic test. At present most clinical chemistry tests, micro channel bend and polymeric pillars are used in polymer based microfluidic devices (such as PMMA) for the blood filtration. In this study, we have fabricated carbon nanotube (CNT) pillars on silicon from 20-50 µm in diameter with varying (~2-10 µm) spacing and integrate them inside the microfluidic channel with a view of using these for blood plasma filtration from whole blood, using passive capillary flow. Our aim is to design a novel sensor (Fig. 1), comprising CNT arrays, to filter RBC's from whole blood, with an integrated micro patterned gold electrode which will be sealed by bonding into microfluidics structures. We have characterized the microfluidic channel by measuring the meniscus movement profiles and the time (filling time) of the fluid flow across the channel without CNT pillar (≈ 5 sec) was less than that of with CNT pillars (≈ 16 sec). Also gold inter-digitated electrodes (IDEs) were fabricated on glass and immobilized with an antibody. These IDEs were used as an impedance-based biosensor using label-free antigen – antibody interaction. At a fixed frequency, the IDEs gave a linear response across the range of concentrations of secondary antibodies investigated (0 to 500 µg/mL). The method employed in this study has tremendous potential for the use of CNTs in microfluidic devices / sensors.

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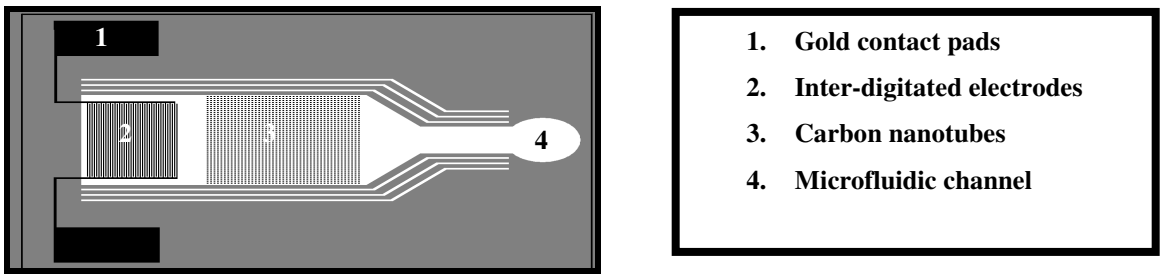

Fig. 1: The schematic (top view) of a microfluidic device with pillars for blood filtration and gold IDEs for impedance measurements.