Carbon nanotube field effect transistor apatasensors for estrogen detection in liquids

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Hormone contamination in waterways could cause serious problems for the environment, as well as being detrimental to human health [1]. There is demand for simple devices capable of detecting low levels of hormones such as 17β-estradial (E2), however the small size of the molecule makes accurate sensitive real-time detection challenging. We are investigating a route to sensitive and selective E2 detection using liquid gated carbon nanotube field effect transistors (CNTFETs) functionalized with aptamers (short strands of DNA) [2,3]. In the presence of the target analyte, the negatively charged aptamer folds to "latch on" to the target, bringing charges closer to the CNTFET and altering the electrical double layer around the CNTFET.

We have developed methods for reproducible fabrication of CNTFET aptasensors using 99% semiconducting CNTs (IsoNanotube–S) on flexible substrates in figure 1 (a) [4,5]. We are able to operate the CNTFETs reliably in aqueous environments, such as water and phosphate buffer solution using an Ag/AgCl reference electrode as the gate. We have investigated a E2 sensor based on a tethered amine-aptamer CNTFET platform [3]. The sensing response of the device to E2 is illustrated via comparison of the device output before and after E2 exposure in figure 1 (b). In this work we investigate how the ionic strength of the liquid environment (water or buffer at various strengths) alters the electric double layer and the subsequent detection sensitivity of E2 in these device platforms. Our findings could pave the way to printable low power biosensor chips that reliably quantify hormone concentrations in a real time measurement.

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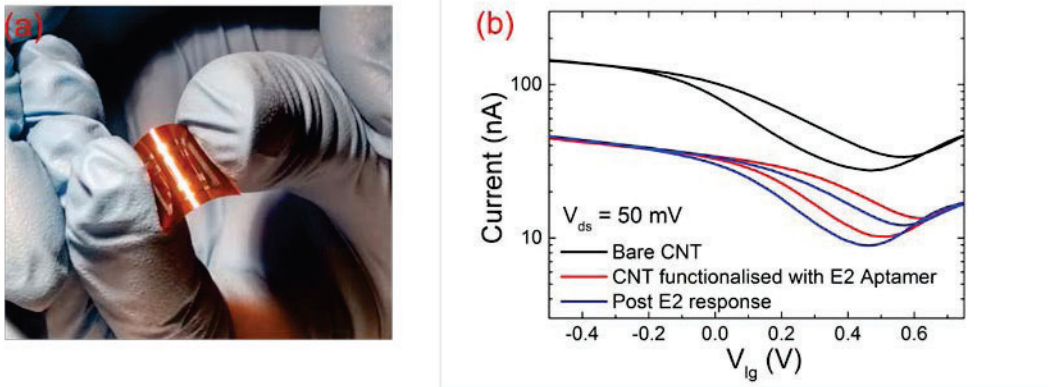

Figure 1: (a) a photo of the CNT FETs fabricated on Kapton film substrates. (b) The liquid gate performance of a CNT FET functionalised with the E2 aptamer, before and after E2 exposure.

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