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CNTFET biosensor design

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The thesis:

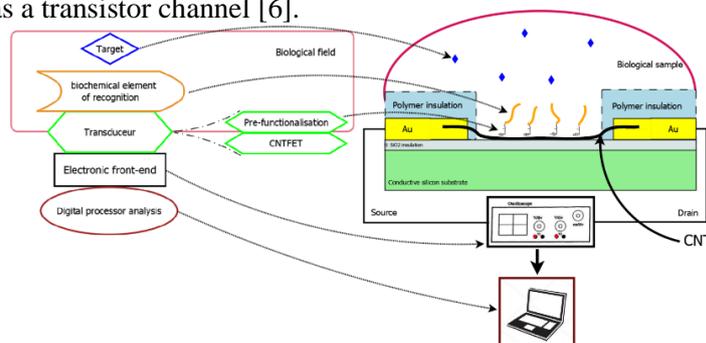
This research starts with a state of the art review on biosensing and applications. Then followed with the design of a structure using the advantages of carbon nanotubes (CNT) as a field effect transistor and as an interface with a biological field. Indeed CNTs are known to be very sensitive to their electrical environment and to chemical changes at close range [1]. Moreover, CNTs, thanks to their hexagonal carbon lattice, can be used as a substrate for organic molecules deposition; allowing the creation of a selective layer [2].

The target:

One of the main drags in cancer research is the ability to observe related biomarkers. We choose here, as a target, one of those biomarkers: the Cyclin dependent Kinase (CDK) complex CDK4/CyclinD. This enzyme is used as a proof of concept for monitoring the activity of the CDK family. Indeed, CDKs, also called *cell division cycle protein*, are responsible for the self-destruction of a tumour cell [3]. An uncontrolled increase in the activity of CDK4/CyclinD complex allows a defective cell to multiply. This enzyme is identified as a biomarker of skin cancers among others [4]. These enzymes use phosphorylation – giving or receiving electrically loaded PO_3 groups – as an activating/deactivating signal.

The sensor:

The designed architecture aims to a sensitive and selective sensor that would also be cheap to manufacture for measurement of CDK4/CyclinD activity. CNTs are placed by dielectrophoresis between facing combs as electrodes [5]. The contacts are then closed with a second layer of Au over the metal-contacting parts of the CNTs. The metal surfaces are insulated with PDMS allowing functionalisation of only the channel parts of the CNTs. Pbase – 1-pyrenebutanoic acid succinimidyl ester – is then used as a linker between the CNT sidewall and a polypeptide – substrate specific to CDK4/CyclinD – forming an ion-selective layer. The activity of CDK4/CyclinD is measured by the rate of presence of PO_3 ions. Indeed, the local changes in charge density can be observed through gate effect on the CNT as a transistor channel [6].



Biosensor functional decomposition and analogy to the CNTFET structure in design

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