NON-COVALENT FUNCTIONALIZATION OF CARBON NANOTUBES TOWARD BIOSENSING APPLICATIONS

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Carbon nanotubes (CNTs) are molecular wires that exhibit interesting structural, electrical and mechanical properties which make them promising material in nanotechnology. Recent development led to the setting-up of carbon nanotube-based biosensors.

Our objective is to design a sensing device directed towards specific antigens using carbon nanotubes as template. For this purpose, the grafting of a moiety which is able to selectively interact with the target is required. We chose as interacting moiety an antibody's fragment known as single-chain fragment variable (scFv).

Obtained through recombinant molecular biology techniques, scFv is the smallest entity retaining high affinity for the antigen, which makes it ideal candidate for new immunosensors. Also, scFv incorporates a poly-histidine tag which will be used for the anchoring of the fragment on the nanotube via selective interactions with nickel ions.

The nanotubes were first functionalized using a lipid made of a nitrilotriacetic acid (NTA) group, as a hydrophilic head, and an alkyl chain, as a hydrophobic tail. The choice of the NTA polar head was governed by the fact that NTA is also able to complex nickel.

In the presence of the nanotube, the lipids self-organize as nano-rings. This non-covalent functionalization preserves the sp^2 nanotube structure and thus the electronic properties of the tube.

The interaction between the scFv and the nano-rings is induced by the formation of a complex between NTA, nickel and the his-tag attached to the scFv. The supra-molecular assembly was characterized by immunoanalysis techniques and by electron microscopy.

Future prospects under investigation are the affinity evaluation of the scFv for the antigen and then, to build up a suitable method to test this assembly towards biosensing applications.

Figure: