Hybrid carbon nanomaterials for electrochemical detection of biomolecules

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It has been estimated that currently up to 27 % of the adult population in Europe are affected by mental and neurological disorders [1]. Many of these disorders are directly related to different neurotransmitters, specifically to the amount of neurotransmitters present in different parts of brain.

Carbon based materials have frequently been used in *in vitro* experiments for detecting neurotransmitters. Recently, promising results in the field of electrochemical detection of neurotransmitters have been achieved by using different types of electrodes coated with thin films of diamond-like carbon (DLC) [2-4] DLC is a metastable form of amorphous carbon of which properties are determined by the ratio of sp^2 and sp^3 bonds, the amount of hydrogen and the deposition method of DLC [5]. All the different DLC types display some of the typical properties of diamond, such as stability, good biocompatibility and resistance to bacterial adhesion [2], making them feasible materials for biomedical applications. However, the sensitivity of the DLC electrodes is typically not high enough to detect the very low concentrations of neurotransmitters present in *in vivo* conditions.

Thus, there is a clear need to combine DLC thin films with other more electrocatalytic forms of carbon or to induce enhanced reactivity to the DLC surface by some other means. In this communication we will present three methods to realize the required higher sensitivity: (i) carbon nanotubes (CNT's) grown directly on top of DLC electrode, (ii) chemically reduced graphene oxide combined with DLC electrode and (iii) introduction of surface topography to DLC by using Ti adhesion layer underneath the electrode material. We will show that all of the three approaches can provide the much increased sensitivity towards our benchmark molecule, which is dopamine, over plain DLC electrodes. However, there are also clear differences among the three types of thin film materials with respect to stability and electron transfer rate, for instance. Finally, we will discuss about further possiblities to fabricate other hybrid nanocarbon materials.

References

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