Microfabrication and electrochemical activation of amorphous carbon nitride a-CNx working electrode integrated in microfluidic chip

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a-CNx films are well-known polarizable interface materials with a large potential window (3 V-4 V [1]) interesting electrochemical reactivity [2] and tunable chemical surfacic composition [3]. Indeed, the surface structure, surface properties, number of grafting sites available are tunable according to the atomic percentage of nitrogen in the a-CNx [4]. High surface reactivity are highly dependent on the surface state and can be affected by synthesis (by varying the Csp^3/sp^2 ratio), and by pre-treatment (electrochemical or plasma). In this work, we elaborated a microfluidic chip integrating a-CNx as working microelectrodes. In brief, a titanium/ platinum (50/500 Å) underlayer was first deposited on the glass wafer and patterned as working microelectrodes for the future thin film a-CNx adhesion and conductivity. On the top of the working electrode, a 220 nm a-CNx (x=0.12), layer was deposited with DC magnetron sputtering (time =20 min, power=200 W) with a graphite target under a flow of nitrogen (P_{N2}/P_{tot} =3%, P_{tot} =0.4 Pa). Then, a classical PDMS fluidic circuit was microfabricated and pre-treated with nitrogen plasma to favor its adhesion onto the glass slide containing the Ti/Pt/ a-CNx microelectrodes. The a-CNx microelectrodes were also electrochemically pre-treated in galvanostatic mode using 0.1 M KOH solution (anodic pre-treatment). The hydrodynamic properties of the fluidic channel a-CNx microelectrodes (as-grown and pre-treated) were screened with the $[Fe(III)(CN)_6]^{3-}/[Fe(II)(CN)_6]^{4-}$ redox couple by cyclic voltammetry and impedance spectroscopy to provide a basis for further investigations such as the influence of a-CNx electrode pre-treatment on the DNA probe density issues in order to enhance the hybridization reaction efficiency with its specific DNA target.

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