# *Chip-on-Paper* for sensoring 8-hydroxy-2'-deoxyguanosine (8-OHdG) oxidative stress biomarker in *point-of-care*

**Gabriela V. Martins**[1,2], Elvira Fortunato[2], Helena R. Fernandes[3], M. Goreti F. Sales[1]

[1]BioMark Sensor Research/CINTESIS – ISEP, Porto, Portugal

[2]Cenimat/i3N – FCT/UNL, Lisboa, Portugal

[3]Laboratório de Metabolismo e Regeneração Óssea, FMDUP, Porto, Portugal

gfdvm@isep.ipp.pt

Early detection of cancer pathologies have been acknowledged has a fundamental tool to improve diagnosis and, subsequently, to increase survival rates concerning this disease. Under this scope, this work presents a label-free approach for the detection of 8-hydroxy-2'-deoxyguanosine (8-OHdG), which is an oxidative stress biomarker that in high concentrations in urine and serum can act as an indicator of cancer disease at an early stage. In the last years, diverse studies have highlighted the role of 8-OHdG has a potential biomarker for carcinogenesis, degenerative diseases and aging [1].

In this work, a carbon-based sensor assembled on paper surface, previously hydrophobized, has been designed for the determination of 8-OHdG (Figure1). The electrochemical behaviour of 8-OHdG was assessed by means of Differential Pulse Voltammetry (DPV), suggesting that this carbon-film enhances the electron transfer of 8-OHdG and then significantly enhances the oxidation peak current of 8-OHdG. All experiments were performed by using the carbon-based sensor as the working electrode, a Platinum (Pt) auxiliary electrode and an Ag/AgCl wire as reference electrode. Thermogravimetric Analysis (TGA), Raman and FTIR spectroscopies were employed to characterize the carbon surface of the sensor device.

Several experimental parameters, such as, potential of pre-accumulation, scan rate and accumulation time have been carefully optimized and the electrochemical performance of the designed sensor was investigated by DPV. It was also found that cleaning treatments to the carbon surface could improve the electrochemical performance of the constructed sensor. Moreover, the influence of the supporting electrolyte and respective pH on the oxidation peak current of 8-OHdG was also investigated. This biosensor can be quickly and easily regenerated by performing voltammetric cycles in buffer solution, removing any memory effect and enabling continuous real-time detection of multiple samples. In parallel, the effect of some nano-based materials (carbon nanotubes, platinum nanoparticles, PEDOT) on the sensor surface was studied, aiming to enhance the electrocatalytic activity of the substrate. The developed electrochemical biosensor showed high sensitivity towards 8-OHdG over the concentration range [50 - 1000] ng/ml (Figure 2). Preliminary results showed the development of a direct and simple sensor with good reproducibility, stability and selectivity. Overall, this label-free biosensor constitutes a promising low-cost tool to be implemented as an easy-to-use protocol for sensitive detection of 8-OHdG in biological samples, along with an excellent capacity of regeneration.

## References

[1] Athanasios Valavanidis, Thomais Vlachogianni, Constantinos Fiotakis, Journal of Environmental Science and Health, Part C: Environmental Carcinogenesis and Ecotoxicology Reviews, **27** (2009) 120-139.

## Acknowledgements

European Research Council is acknowledged for funding this work through the Starting Grant 3P's (GA 311086, MGFS). Gabriela V. Martins acknowledges FCT the PhD Grant ref. SFRH/BD/94159/2013.

## Figures

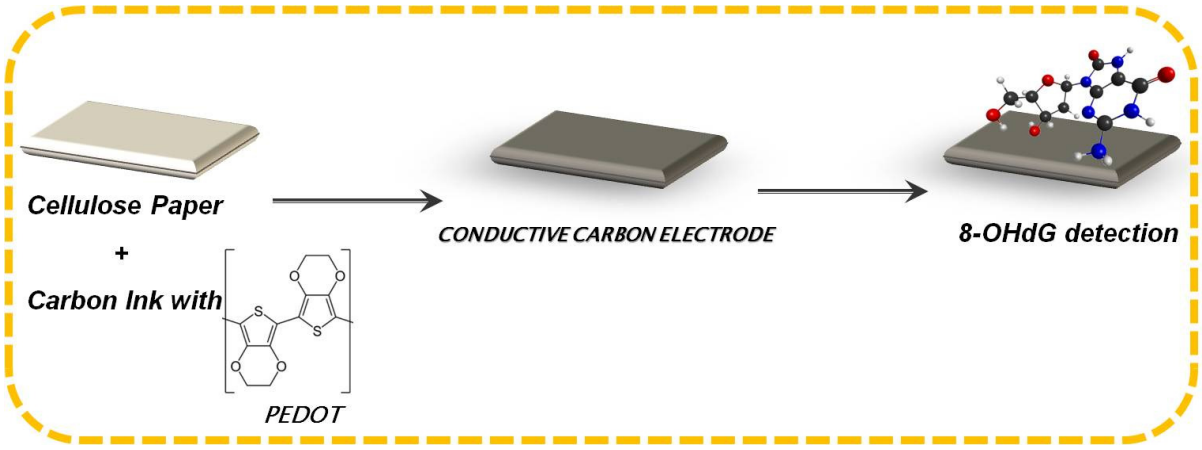


**Figure 1:** Schematic representation of the assembly of the carbon-based sensor for 8-OHdG detection.

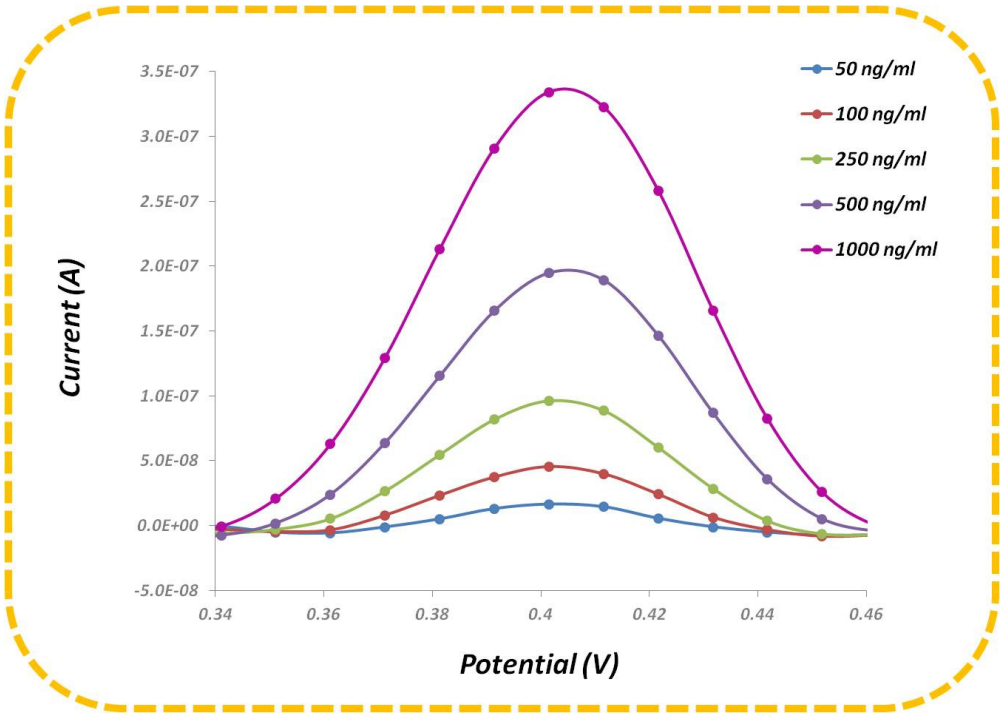


**Figure 2:** Successive differential pulse voltammograms in PBS pH 7.4 for different concentrations of 8-OHdG.