Selective Sensing of Dopamine using a Nafion® coated Overoxidized Polypyrrole electrode.

Paul Moorhead, Carmel Breslin and Denise Rooney

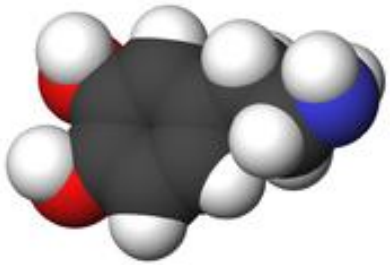
Department of Chemistry,

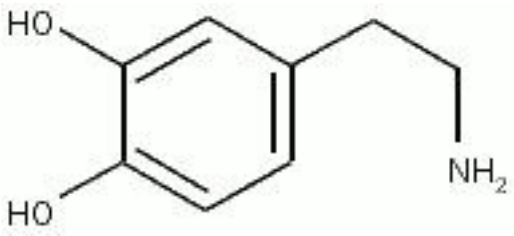
National University of Ireland Maynooth,

Co. Kildare,

Ireland

Introduction.



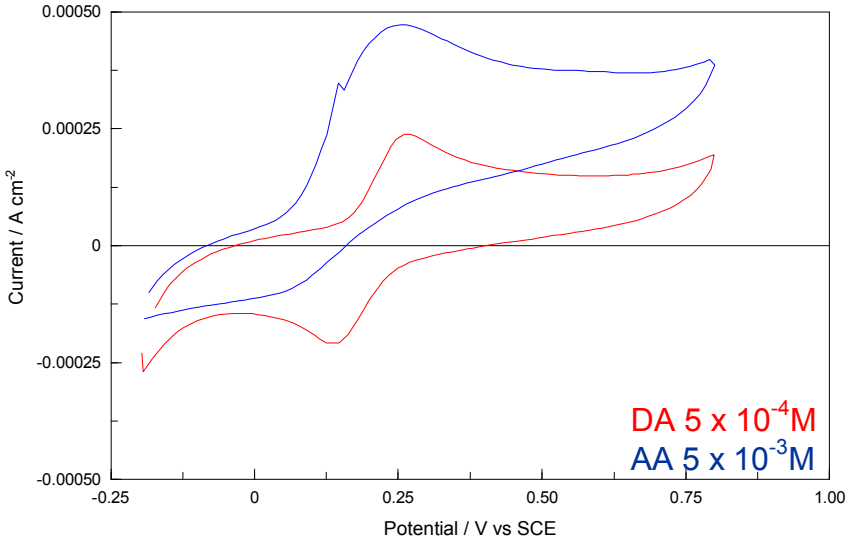


Dopamine (DA) is an important neurotransmitter.
Dopamine mediates the transmission of messages within the central nervous system, abnormal levels of dopamine are related to diseases such as Parkinson's, Alzheimer's and Schizophrenia.

Jing Li, Xiangqin Lin. *Sensors and Actuators B 124* (2007) 486.

Introduction.

Dopamine is electrochemically active therefore the development of an electrochemical method that is capable of sensing dopamine has been at the forefront of much research.



However, the electrochemistry is made extremely difficult by the presence of interfering compounds, such as ascorbic acid which exist in in vivo at concentrations of over 100 times that of dopamine and the oxidation potentials overlap.

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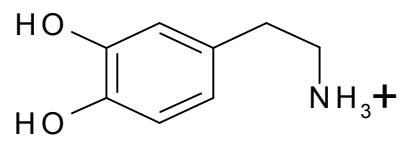

-2H+

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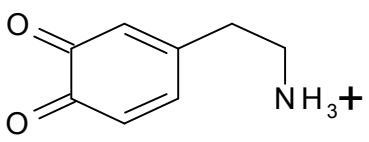
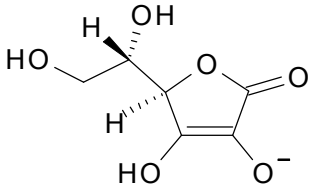
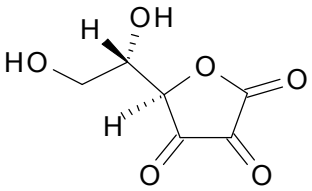


Protonated Dopamine

Dopamine-o-Quinone



Ascorbate Anion



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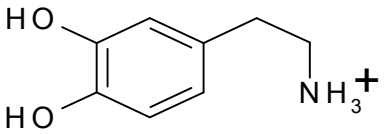

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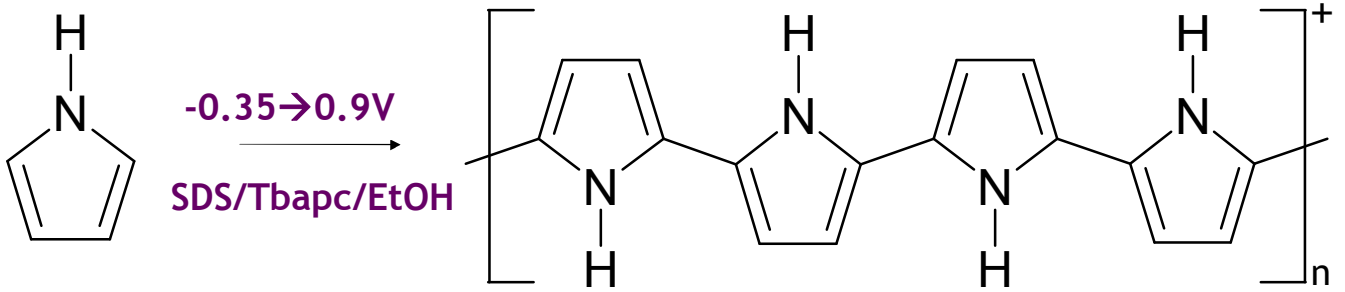
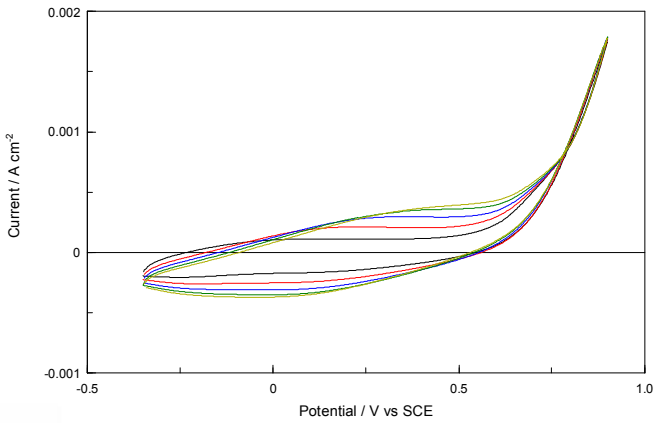
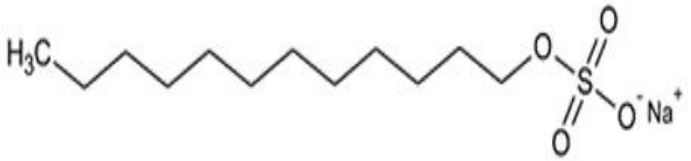
Manufacturing the electrode.



Pyrrole

Polypyrrole





Sodium Dodecyl sulfate (SDS)

Tetrabutylammonium perchlorate (Tbapc)

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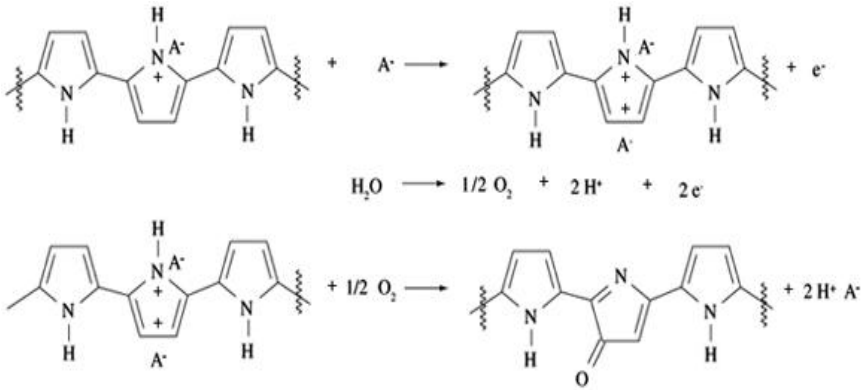
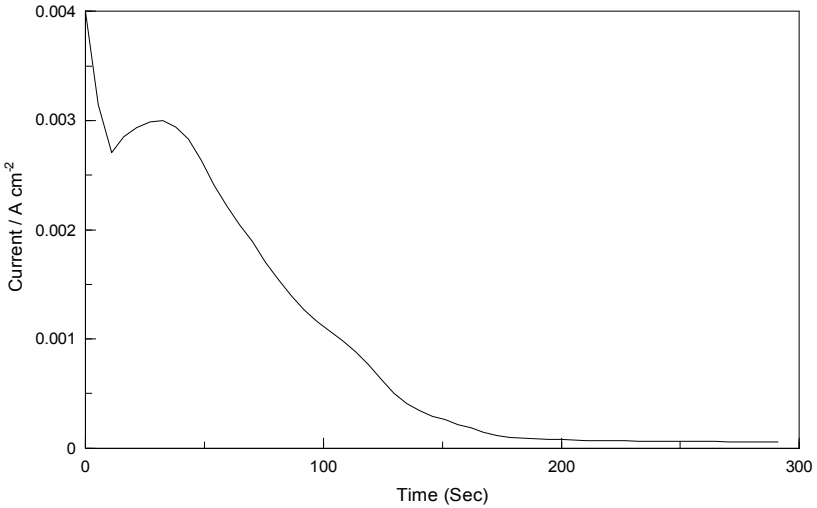
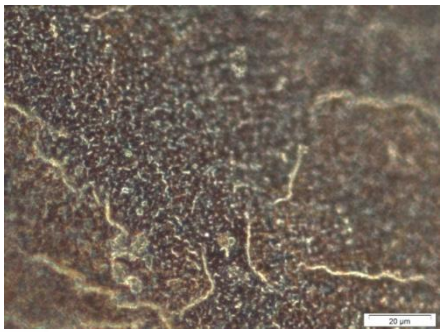
Manufacturing the electrode.



Reactions that occur during the overoxidation of the polypyrrole.



Overoxidation of polypyrrole @ 1.0 V.



There are 2 reasons for overoxidising the polymer-

- **the polymer goes from a positive to neutral.**
- **it reduces the background currents, allowing for greater sensitivity.**

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Andréa Santos Liua, Materials Research, (2007)Vol. 10, No. 2, 205-209,.

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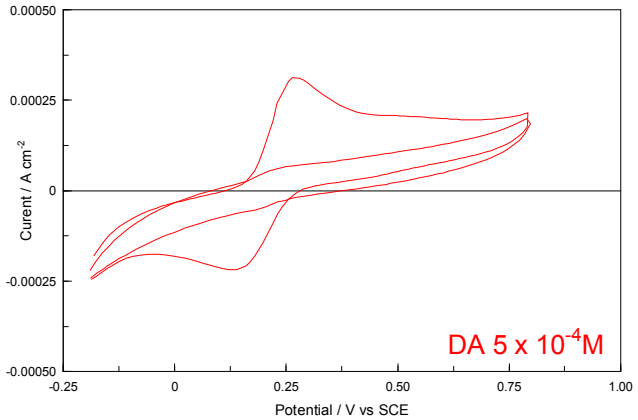
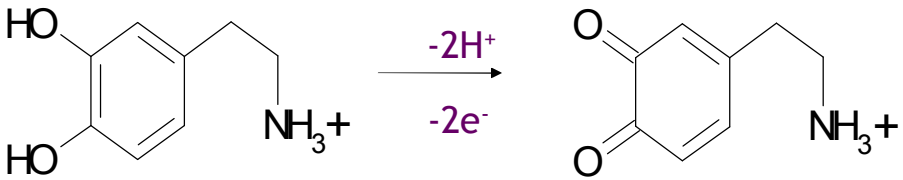
The role of SDS within the polymer.



SDS
Tbapc / ClO_4^-

The Oxidation of Dopamine



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Dopamine-o-Quinone

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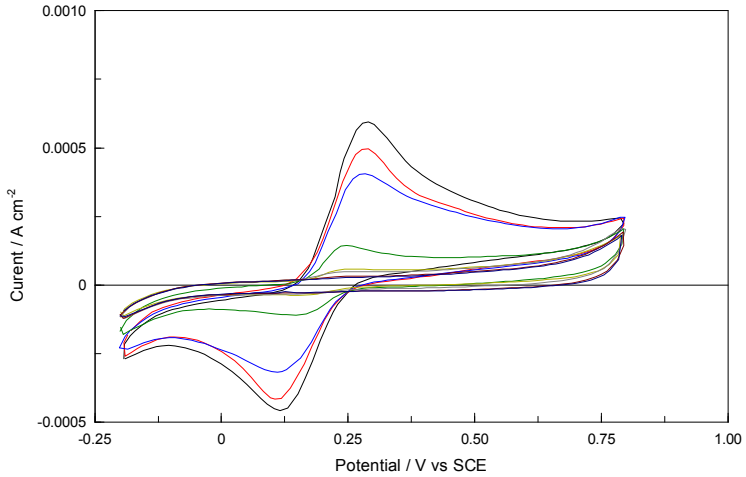
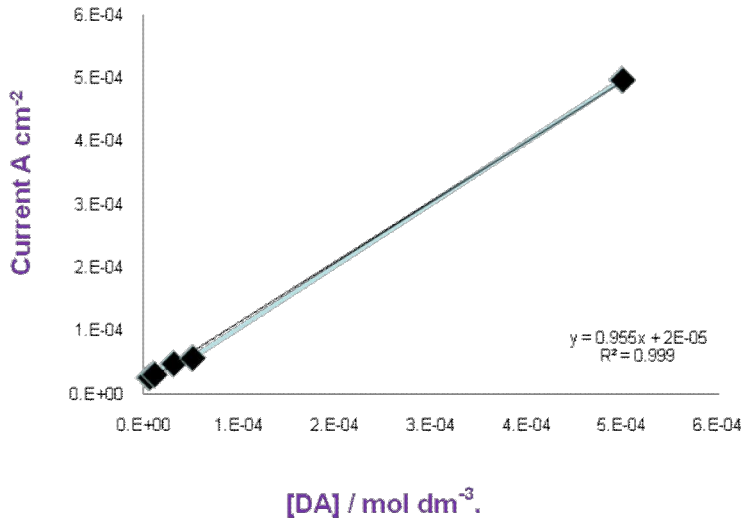
Concentration of Dopamine.





Sensitivity is 2.5 x 10^{-5} M DA

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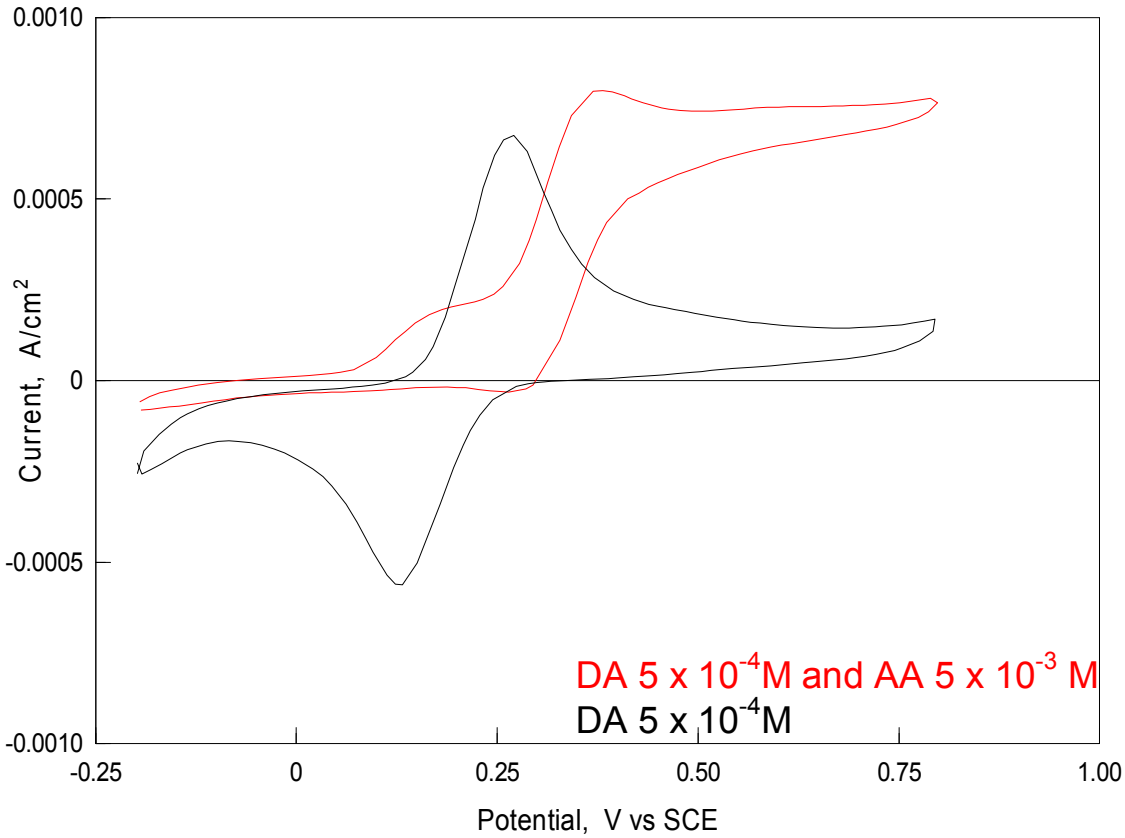
Influence of Ascorbic acid.



AA interference with the DA signal.

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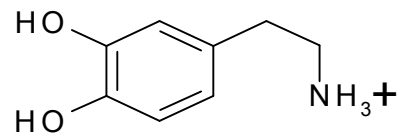

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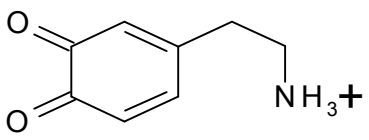

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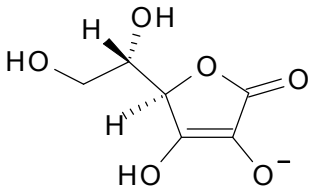

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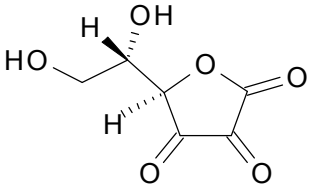

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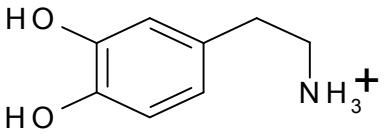

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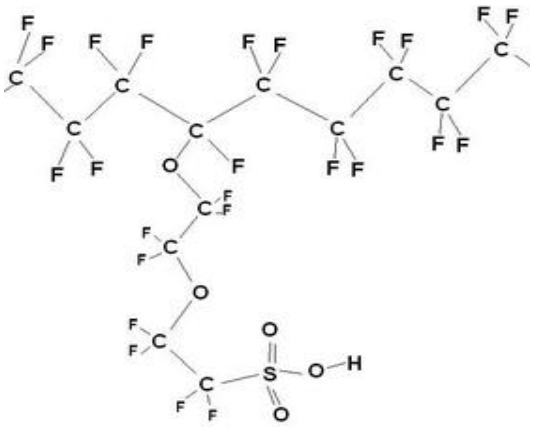
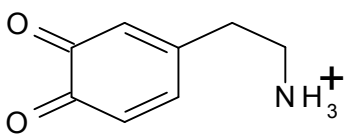
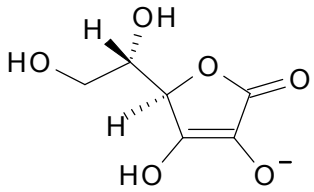
Nafion®



Nafion®

The chemical basis of Nafion's superior conductive properties remain a focus of research. Protons on the SO_3H (sulfonic acid) groups move from one acid site to another. Pores allow movement of cations but the membranes do not conduct anions or electrons.





Ion-selective Nafion® is used to block out the anionic (-ve charged) Ascorbic acid and attract the cationic (+ve charged) dopamine.

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Shah R. Ali, et al. *Anal. Chem.* 79, (2007) 2583-2587

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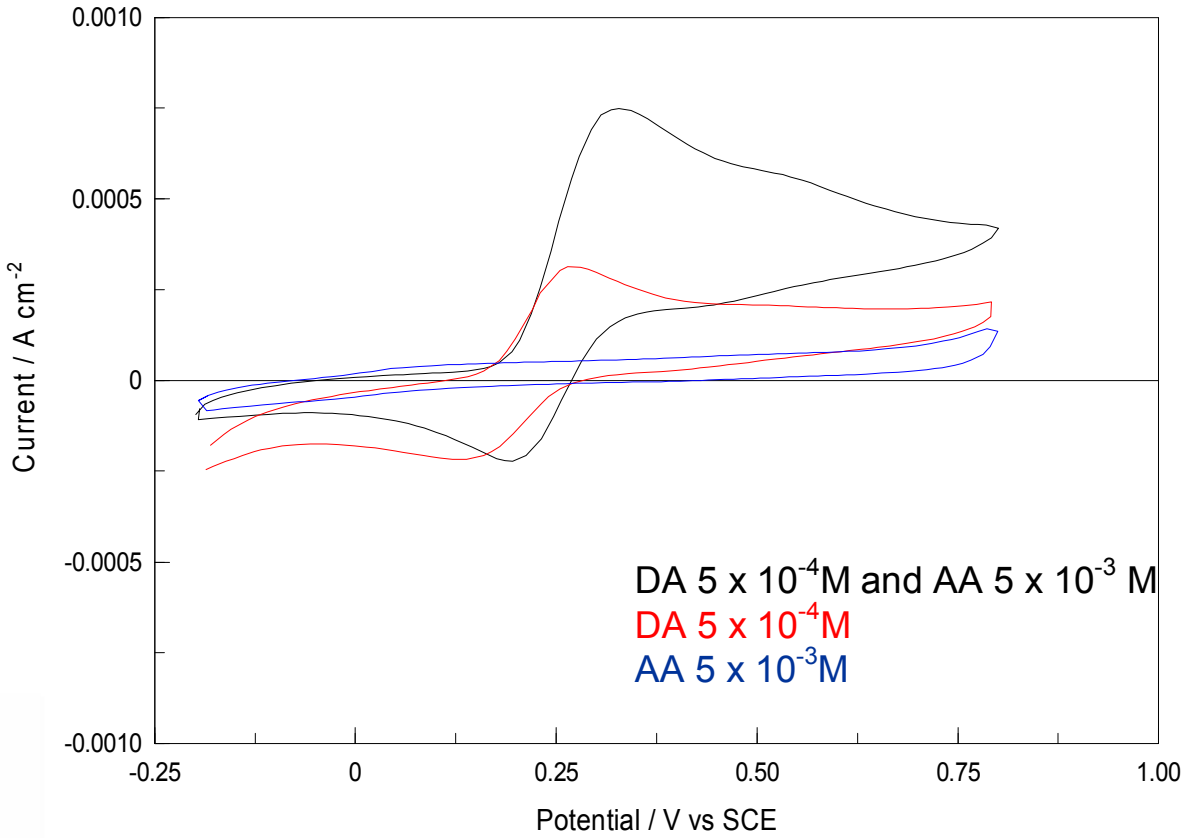
Polymer electrode without Nafion® coating



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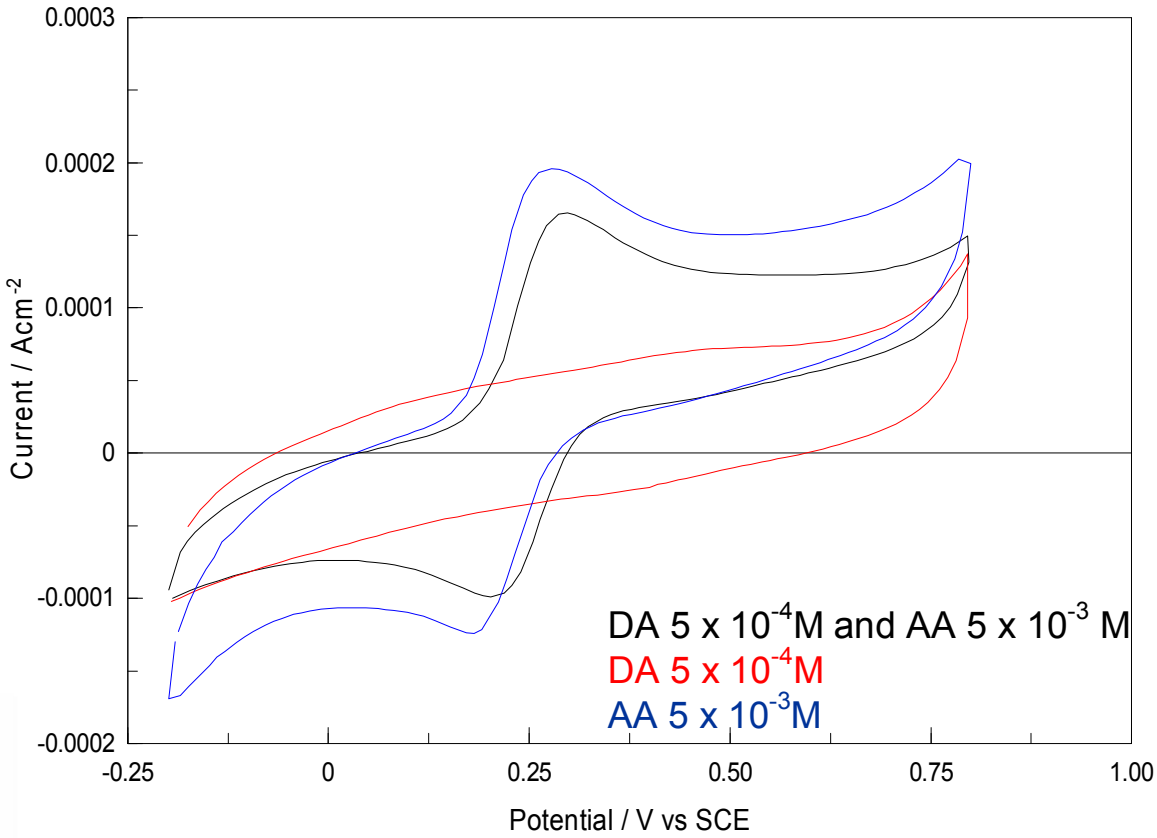

Future work

Incorporating Au nanoparticles – ongoing

Considering other large dopants –SDS

Refining the application of Nafion®.

My thanks to

Prof. Carmel Breslin
Dr. Denise Rooney
And All Postgraduate and Postdoctoral Researchers in Maynooth

Centre of Applied Science for Health

The Centre of Applied Science for Health

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Programme for Research in Third Level Institutions Cycle 4

Ireland's EU Structural Funds Programmes 2007 - 2013

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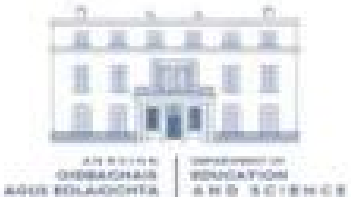
EUROPEAN UNION STRUCTURAL FUNDS



HEA

Higher Education Authority
An tÚdarás um Ard-Oideachas

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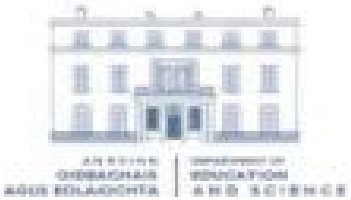

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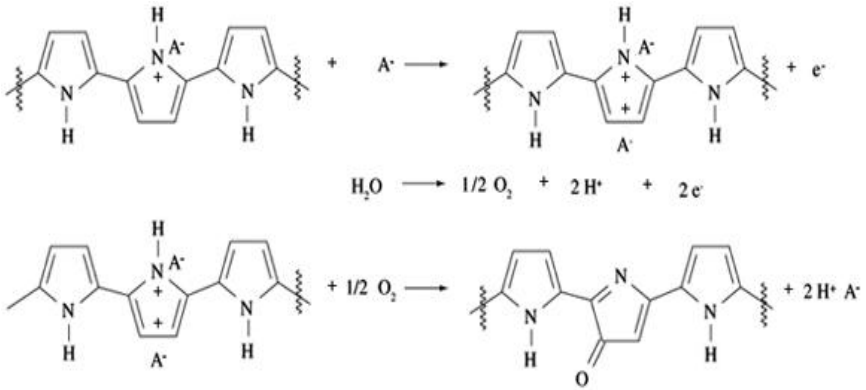

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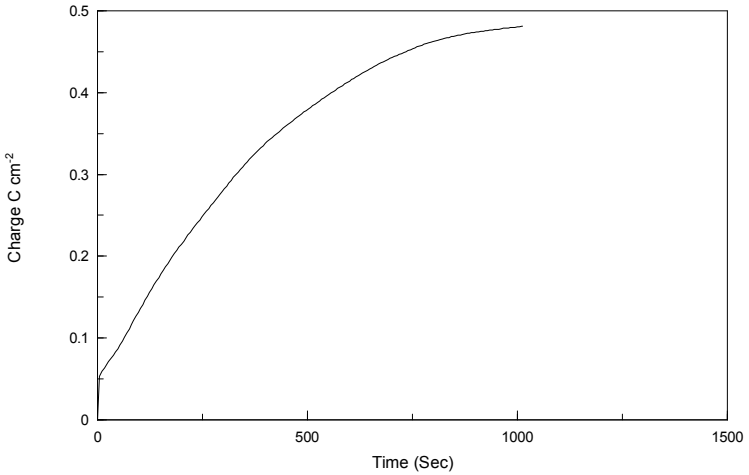

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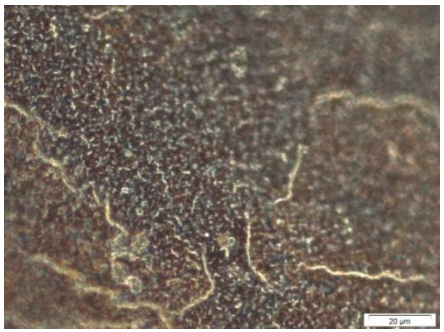

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