

# Fabrication, Characterisation and Modification of a Carbon Film Microelectrode to Selectively Monitor Dopamine *In Vivo*.

by

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## ***Abstract***

*In this thesis a procedure is presented for the fabrication of a microelectrode to monitor the neurotransmitter dopamine in vivo. The microelectrodes are fabricated by in situ pyrolysis of acetylene under a nitrogen blanket onto a quartz capillary. The carbon film was then anodically oxidised in the presence of 2,4-dinitroaniline. These microelectrodes are stable, provide the physical strength to penetrate brain tissue, have a low capacitance, are resistant to fouling in vivo and selectively suppress the endogenous ascorbic acid which oxidises at the same potential as dopamine. With such properties the carbon film microelectrode appears ideally suited for fast scanning cyclic voltammetric studies of cationic neurotransmitters, such as dopamine, in vivo.*

*During this thesis work the following properties of the carbon film were reported:*

*Electrochemical heterogeneous electron transfer characteristics*

*Use of acetylide pendent groups in adsorptive stripping voltammetry of cation  $\pi$  cation complexes to sub ppb sensitivity.*

*The catalysis of the anodic oxidation of dopamine was found to be pH dependent and independent of the adsorbed dopamine quinone.*

*The adsorption of the dopamine quinone was found to dependent on the hydroxyl groups, not the amine group as previously reported for carbon fibres.*

*Anodic oxidation of ethanol forms ethanoic acid on the surface linked via the  $\beta$  carbon, not an ether linkage as previously reported.*

*The inherently stable surface can be expected to provide a single or dual platform for other analytical applications and, when unmodified, in speciation studies of  $\pi$  complexing cations.*

*Improvements in fabrication, such as pyrolysis temperature and carbon film thickness control will enable this unique carbon surface structure to be utilised for additional electrochemical analytical applications.*

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## **Declaration**

I hereby declare that this thesis represents my own work entirely, except where specifically indicated otherwise in the text, and has not been submitted for a higher degree to any other university or institution.

Michael McNally

Dated

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## *List of Abbreviations*

AA	Ascorbic acid
AQDS	9,10-anthraquinone-2,6-disulfonic acid disodium salt
DA	Dopamine
DBU	1,8-Diazabicyclo[5.4.0]undec-7-ene
DCM	Dichloromethane
EMI	Electromagnetic interference
GC	Glassy carbon
HOPG	Highly orientated pyrolytic graphite
LDT	Laterodorsal tegmental
PG	Pyrolytic graphite
PQ	9,10-Phenanthrenequinone
SEM	Scanning electron microscopy
TEAHFP	Tetraethylammonium hexafluorophosphate
XPS	X-ray photoelectron spectroscopy