Electrochemical behaviour of boron-doped diamond electrodes

by

Kaveshini Naidoo

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Kaveshini Naidoo

Supervisor: Dr Raluca I Stefan
Co-Supervisor: Professor Jacobus F. van Staden
Department of Chemistry
University of Pretoria

Degree: Magister Scientiae

SYNOPSIS

Conducting diamond electrodes provide unique advantages for electrochemistry such as a wide potential window, low baseline current, chemical inertness and resistance to fouling. De Beers boron-doped diamond electrodes, manufactured by chemical vapour deposition and containing varying amounts of boron, were therefore investigated in order to determine their suitability for future electrochemical applications. These electrodes were initially characterised using techniques such as SEM, LA-ICP-MS, Raman spectroscopy and XPS. The electrochemical behaviour of these electrodes was investigated in two redox systems (potassium iron (III) cyanide and cerium (III) sulphate) and two biological systems (dopamine and ascorbic acid). These results were compared against that of the conventional glassy carbon electrode. Porous boron-doped diamond, a novel electrode material, was used for the electrochemical detection of thyroid hormones (L-T₃ and L-T₄).
These hormones have never previously been investigated using a boron-doped diamond electrode.

The De Beers boron-doped diamond electrode was found to outperform the conventional glassy carbon electrode, which fouled very easily, in the detection of dopamine. Peak separation between dopamine and the interfering ascorbic acid was attained at a pretreated boron-doped diamond electrode. The feasibility of detecting thyroid hormones using a porous boron-doped diamond electrode was demonstrated, and the electrode material was patented.
Elektrochemiese gedrag van boorbevattende diamantelektrodes
deur
Kaveshini Naidoo

Leier: Dr Raluca I. Stefan
Medeleier: Professor Jacobus F. van Staden
Departement Chemie
Universiteit van Pretoria

Graad: Magister Scientiae

SAMEVATTING

Geleidende diamantelektrodes lewer unieke voordele in elektrochemie, soos 'n wye potensiaalgebied, 'n lae basislyn, onreaktiewe chemiese eienskappe, en 'n weerstand teen die vorming van 'n neerslag op die oppervlakte, wat die elektrodewerking belemmer. De Beers se boorhoudende diamantelektrodes, wat verskeie hoeveelhede boor bevat, is ondersoek met die doel om hul geskiktheid vir toekomstige elektrochemiese toepassings te bepaal. Hierdie elektrodes is berei deur die neerslag van koolstof in die dampfase in die teenwoordigheid van boor. Dit is aanvanklik gekarakteriseer deur gebruik te maak van tegnieke soos SEM, Raman spektroskopie en XPS. Hierdie elektrodes is getoets in twee redoksisteme (kalium yster(III)sianied en serium(III)sulfat) en twee biologiese sisteme (dopamien en askorbiensuur). Die verkree resultate is vergelyk met dié van konvensionele glasagtige koolstofelektrodes. Porieuse boorbevattende diamant, 'n unieke
elektrodemateriaal, is aangewend vir die elektrochemiese bepaling van skildklierhormone (L-T₃ en L-T₄). Hierdie hormone is nog nie voorheen bepaal deur gebruik te maak van hierdie tipe elektrode nie.

De Beers se boorhoudende diamantelektrode het die werking van die gewone glasagtige koolstofelektrode oorskry; by laasgenoemde vorm 'n aanpaksel op die elektrodeoppervlakte baie geredelik in die bepaling van dopamien. Die skeiding van dopamien en belemmerende askorbiensuur, is bewerkstellig deur gebruik te maak van hierdie elektrodes. Die moontlikheid om skildklierhormone te bepaal d.m.v. 'n porieuse boorhoudende diamantelektrode is aangetoon, en hierdie elektrodemateriaal is gepatenteeer.
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And finally, I would like to express my sincere love and gratitude to my family and friends, for their encouragement, love and support in this undertaking.
To Jesus, my closest friend,

In all things, you do so righteously tend,

Unlike, the billowing sand,

Which may lead to a barren land,

I have no fear, 'cause you have my life in the palm of your hand

And so, in you I will forever love and trust.
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