



Characterization of the electrical properties of polyaniline in the temperature range 30 – 450 K

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Submitted in partial fulfillment of the requirements for the degree

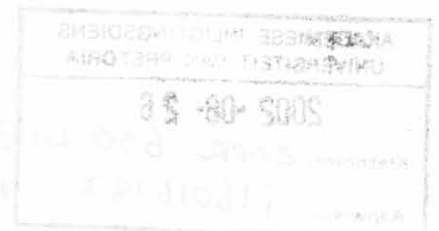
MASTERS OF SCIENCE

In the faculty of natural and agricultural sciences at the University of Pretoria

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August 2001





ACKNOWLEDGEMENT

Firstly I would like to thank my supervisor Professor S. A. Oosthuizen for guiding me throughout this study and for being there for me.

I also would like to thank the following people for their help and contribution:

- My co-supervisor Prof. P. J. P. van der Merwe for his guidance and support.
- Prof. M. P. van der Merwe for his help with the chemical synthesis, purification and laboratory instruments and chemical synthesis.
- Prof. P. van der Merwe for his help with spectroscopic analysis and data analysis.
- The metallurgy department for providing me with a nickel and palladium alloy pellets.
- Prof. C. Myberg, for helping me with platinum electrode and working electrode cell.
- Dr. N. Van de Berg, for helping me with graphite rods.
- My fellow students and members of the physics department whose contribution and assistance provided me with a pleasant and enjoyable time during the study.
- The persons who have read and commented on this report and who helped me to improve it.
- My family for being there all the time.

To my loved ones

Thank God



ACKNOWLEDGEMENT

Firstly I would like to thank my supervisor Professor S. A Goodman for guiding me throughout this study and for being there for me.

I also would like to thank the following people for their valuable contributions:

- My co-supervisor, Prof. F.D Auret for his guidance throughout this study
- Prof. W. Folker for his help with the chemistry of conducting polymers, several laboratory instruments and polymer synthesis
- L. Prinsloo, for her help with spectroscopic analysis of polyaniline
- The metallurgy department for providing me with a mortar and pestle for making pellets
- Prof. G. Myberg, for helping me with platinum electrodes and an electrochemical cell
- Dr. N. Van de Berg, for helping me with graphite rods
- My fellow students and members off the physics department whose contribution has always been positive towards completion of this study
- My parents, sisters, brothers and cousins for letting me know what they expect of me
- Michi, for being there all the time.

Finally, God bless.

The following were observed:

- Conductivity in polyaniline is governed by disordering and
- The decrease in conductivity with increase in disordering is due to the increase in the loss of dopant ions and polymer degradation
- The variable range hopping model in three dimensions adequately describes the charge transfer mechanism in polyaniline
- Conductivity in polyaniline is temperature activated
- Conductivity varies with position on the multiple surface
- The effect of polier poisoning on pure and conductive is negligible
- Contact voltage across transfer for polyaniline exhibits a linear relationship with current values, $(\pm 0.2 \text{ mV})$ for $I = 1 \times 10^{-4} \text{ A}$ against $I = 1 \times 10^{-5} \text{ A}$ measured by four point probe measuring instrument



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SUMMARY

1 INTRODUCTION

Despite the poor understanding of charge transfer in conducting polymers, conducting-polymer-based devices have achieved considerable commercial success. This success is based largely on the reproducibility of the measurable properties. It is the purpose of this study to further clarify charge transfer characteristics of conducting polymers under varying conditions.

We studied a conducting polymer called polyaniline. Polyaniline was available in its doped conducting form called emeraldine salt and in its undoped form called emeraldine base. Three types of polyaniline were studied, electrosynthesized (doped by HCl), chemically synthesized (doped by HCl) and commercial polyaniline obtained from Adrich Company and doped by camphor sulfonic acid.

Initially we investigated whether charge transfer was ionic or electronic by observing the change in resistance with time for a fixed applied current. It was concluded that conduction in this material is electronic. Electrical measurements were obtained using the four-point probe and the Montgomery methods. The samples investigated were in pellet and film forms.

We investigated charge transfer over the temperature regime 30-450 K by applying the following methods: scanning electron microscopy to investigate the surfaces of pellet and film samples, Fourier transform infrared spectroscopy and Raman spectroscopy to investigate the effect of annealing on the molecular structure of the polymer and thermal analysis to investigate the loss of substances from the polymer as a result of the annealing process. The conductivity of the material was also analyzed over the entire temperature regime.

The following were observed:

- Conductivity in polyaniline is governed by monomer units.
- The decrease in conductivity with increase annealing temperature is related to moisture loss, loss of dopant ions and polymer degradation.
- The variable range hopping model in three dimensions, satisfactorily describes charge transfer mechanism in polyaniline.
- Conductivity in polyaniline is temperature activated.
- Conductivity varies with position on the sample surface.
- The effect of pellet pressing pressure to conductivity is negligible.
- Current-voltage characteristics for polyaniline exhibit non-ohmic behavior at high current values, (> 0.2 mA for $T < 80$ K), applied between the current probes of a four-point probe measuring instrument.

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