AIN SHAMS UNIVERSITY FACULTY OF GIRLS FOR ART, SCIENCE AND EDUCATION PHYSICS DEPARTMENT

STUDY OF THERMAL PROPERTIES FOR SOME LIQUIDS

Thesis Submitted in Partial Fulfillment of the Requirement for M. Sc. Degree in Physics

Presented By

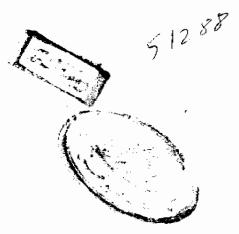
Tarik Ahmed Mohamed El-Sayed (B. Sc.)

Supervising committee

Prof.Dr. M.A. Kenawy Physics Department College of Girls Ain Shams University

Prof.Dr. S.R. Atalla Physics Department Faculty of Education Fayoum Branch, Cairo University

Dr. G. Attia
Physics Department
Faculty of Education
Fayoum Branch, Cairo University



Name of Student: Tarik Ahmed Mohamed El-Sayed

<u>Title of Thesis:</u> Study of Thermal Properties for Some Liquids

Name of Faculty: Faculty of Science

University: Helwan University

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TO MY PARENTS, MY WIFE, AND MY CHILDREN

بسم الله الرحمن الرحيم

"و قل رب أدخلنى مدخل صدق و أخرجنى مخرج صدق و اجعل لى من لدنك سلطانا نصيرا"

صدق الله العظيم

(الاسراء:٨٠)

CONTENTS

Page

Summary

Introduction

Chapter 1				
Theory of The Thermal Properties of Liquids.				
1.1 8	Strcture of liquids	1		
1.2 T	Thermal motion	4		
1.3 1	Theory of the thermal conductivity of liquids	6		
1.4 T	Thermal diffusivity	10		
1.5 S	Specific heat capacity	11		
1.6 H	leat transfer by convection	15		
1.7 H	Heat transfer by radiation	16		
Chapter 2				
Non-	Steady State Methods			
2.1 T	the flash method	20		
2.2 T	The transient hot wire technique	23		
2.3 T	The forced-Rayleigh-scattering method	27		
2.4 T	The photothermal radiometry method	28		
2.5 T	The transient thermoreflectance method	29		
2.6 T	The wave-front-shearing method	30		

Chapter 3
Theory of the AC-Heated Strip (Wire) Technique for
the Determination of Thermal Properties of Solids
and Liquids
3.1 The plane temperature wave method for determination
of the thermal activity of liquids and solids 32
3.2 The radial heat flow method for the determination of
thermal properties of liquids and solids 36
Chapter 4
The Experimental Set-Up
4.1 Description of the set-up
4.1.1 The metallic chamber 40
4.1.2 The Ac bridge
4.1.3 The calibration Circuit
4.2 Determination of the amplitude of the temperature
oscillations (0)
4.3 Relation between the measured e_{3w} and its generated
value 48
4.4 Performance of the experiment 50
4.5 Processing of the experimental data 52
4.6 Analysis of the experimental errors 54
4.7 Calibration of the experimental set up 56
4.7.1 Measurement of the temperarure resistance
coefficient of the platinum wire 56

F	Page
4.7.2 Results of the measurement of the thermal	
properties of water	57
4.7.3 Results of the measurement of the thermal	
properties of toluene	59
Chapter 5	
Results and Discussion	
5.1 Co(NO ₃) ₂	62
5.2 CH ₃ CONH ₂	64
5.3 Conclusions	66
References	67

SUMMARY

SUMMARY

Thermal properties are material properties of great importance when transfer of heat is involved. In recent years, because of the increase in new materials technology and increasing temperaure ranges of operation, there has been a corresponding increase of interest in the measurement of these properties.

For this purpose an experimental set-up was built in a quite modified form in the Department of Physics, Faculty of Education, Fayoum Branch, Cairo University, for the simultaneous measurement of thermal activity, thermal diffusivity, thermal conductivity and heat capacity of solids and liquids. This set-up is based upon the AC-heated wire(strip) technique.

The set-up was then calibrated with distilled water and toluene which are considered as standard substances. Then it was used for the measurement of thermal properties of cobalt nitrate salt and acetamide in the solid and liquid states in the temperature range 300-400 K. Also DSC investigations were carried out for these materials.

The obtained DSC results for cobalt nitrate showed that this substance melts at 59.2 °C. The thermal properties of Co(NO₃)₂ were measured up to 115 °C. The obtained results

for the volumetric heat capacity show that the investigated temperature range is above the Debye temperature for this substance. The obtained results for the thermal conductivity coefficient show that heat conduction in this salt takes place mainly due to phonons.

For acetamide (CH₃CONH₂), the DSC results show that it melts with its peak at 89.9 °C. The thermal properties of this material were measured up to ~120 °C. The obtained results for the volumetric heat capacity show that the investigated temperature range is above the Debye temperature for this substance. The thermal conductivity results show that the heat conduction mechanism is again mainly due to phonons as expected.

The upper limit of the investigated temperature range was dictated by the fact that at 115 °C for $Co(NO_3)_2$ and 120 °C for acetamide, no balance of the AC-bridge was achieved above the mentioned temperatures. This fact needs to be further investigated to find out the reason behind this phenomenon. This is specially important because the same phenomenon was observed by us for other nitrate salts like $NaNO_3$ AgNO₃ and $Zn(NO_3)_2$.

It is our objective to modify the experimental set-up to improve its accuracy, and investigate the thermal properties, at higher range of temperature, of other nitrate

salts and combinations of organic materials with some additions of metallic nitrates. These materials are very important for energy technology and seem to be quite good heat storage candidate materials.

INTRODUCTION

INTRODUCTION

The development of new materials and new technologies needs thermophysical property data of information on more Thermophysics plays therefore a different. substances. leading role in the characterization of materials, contributing definitely for the advancement of material science and technology. In recent years, molten salts have been attracting attention as heat transfer media or thermal storage materials at high temperatures.

Due to the lack of a complete theory of the liquid state in general, and the theory of thermal properties in particular, accumulation of experimental data about the physical properties of nitrate salts will help the better technical use of these materials. From the sceintific point of view, knowledge of the thermophysical properties helps the understanding of the structure, and the nature of thermal motion in this important class of chemical compounds.

Numerous methods have been devised and modified for the measurment of thermal properties of melts. These methods are divided into two main categories; classical and non-classical. By classical were designated all the methods that measure directly temperature gradients generated by heat flow, while the remaining methods involve indirect ways to access the temperature gradients and high power sources [1].