

Table of contents

Table of content	i
List of Figures	v
List of Tables	ix
Preface	xi
Chapter-1: Introduction and measurement of thermodynamic properties by different techniques	(1-41)
1.1 Introduction.....	1
1.1.1 Health hazards from inhaling and exposure to soldering fumes.....	2
1.1.2 Resistance to Lead-Free Soldering.....	3
1.2 Significance of thermodynamic parameters.....	6
1.3 Thermodynamic properties of solutions.....	7
1.4 Activity measurement techniques.....	8
1.4.1 Chemical Equilibria.....	8
1.4.2 Vapour Pressure Measurement.....	10
1.4.3 Static Methods.....	11
1.4.3.1 Direct Methods.....	11
1.4.3.2 Indirect Methods.....	12
1.4.4 Dynamic Methods.....	12
1.4.5 Effusion Methods.....	14
1.4.6 Electrochemical Methods.....	16
1.4.6.1 General Principles.....	16
1.4.6.2 Theoretical Considerations.....	17
1.4.6.3 Choice of Electrolyte.....	19
(a) Molten or Fused Salt Electrolytes.....	20
1.5 Calorimetric technique.....	23
1.5.1 Principle of calorimeter.....	24
1.5.2 Classification of calorimeters.....	25
1.5.2.1 Adiabatic calorimeter.....	25
1.5.2.2 Isothermal calorimeter.....	26
1.5.2.3 Isoperibol calorimeter.....	26
1.5.2.4 Solution calorimeter.....	26
1.5.2.5 Bomb calorimeter.....	28
1.5.2.6 Constat temperature gradient calorimeter.....	28
1.5.2.7 Variable temperature gradient calorimeter.....	29
1.5.2.8 Drop calorimeter.....	30
1.5.2.9 Direct drop calorimeter.....	31
(a) Determination of heat capacity.....	31
(b) Determination of enthalpy of transition.....	32
(c) Determination of reaction by ignition (direct synthesis).....	32
1.5.2.10 The solution drop calorimetry.....	33
(a) Determination of heat of dissolution.....	33
(b) Determination of heat of formation.....	34
1.5.2.11 MHTC96 high temperature drop calorimeter from Setaram, France.....	34
(a) Motorized lifting device.....	35
(b) Multi-Sample Introducer.....	35
(c) High temperature furnace.....	36
(d) Degassing unit.....	39

(e) Drop tube.....	39
(f) Crucibles.....	39
(g) Software evolution controller.....	39
(h) Rear Power rack part.....	40
Chapter-2: Experimental procedure and techniques	(43-64)
2.1 Introduction.....	43
2.2 Materials.....	43
2.3 Electrochemical Methods.....	44
2.3.1 General Principles.....	45
2.3.2 Theoretical Considerations.....	46
2.4. Experimental Set-up.....	47
2.4.1 The Galvanic Cell Assembly.....	48
2.4.2 Furnace and Measuring Instruments.....	48
2.4.3. Experimental Procedure.....	51
2.4.4 Method of Calculation.....	52
2.5 Calorimetric technique and procedure.....	57
2.5.1 Drop calorimeter.....	57
2.5.2 Experimental Procedure.....	57
2.5.2.1 Starting up the instrument.....	57
2.5.2.2 Starting up the Calisto software.....	58
2.5.2.3 Programming the experiment.....	58
2.5.2.4 Sample Loading.....	59
2.5.2.5 Starting the experiment.....	59
2.5.2.6 Area measurement.....	60
2.5.2.7 Necessity of calibration.....	60
2.5.2.8 Calibration with a single standard.....	61
2.5.2.9 Calibration with multiple standards.....	61
2.5.2.10 Enthalpy calculations.....	62
2.5.2.11 Calibration constant (K) calculation.....	64
Chapter-3: Measurement of activity of In in liquid Bi-In-Sn alloys by EMF method.....	(65-92)
3.1 Introduction.....	65
3.2 Literature review.....	67
3.3 Experimental.....	69
3.3.1 Electrochemical Measurements.....	69
3.4 Results and discussion.....	73
3.4.1 Activity of indium.....	73
3.4.2 Integral molar excess free energy in In-Bi-Sn at 813K.....	82
Chapter-4: Drop calorimetric measurement of binary Bi-Sn, Bi-In and In-Sn system	(93-120)
4.1 Introduction.....	93
4.2 Literature review.....	94
4.2.1 Bi-Sn System.....	94
4.2.2 Bi-In system.....	95
4.2.3 In-Sn system.....	96
4.3 Experimental Procedure.....	98
4.3.1 Materials.....	98
4.3.2 Drop calorimetric measurements.....	99
4.4 Results and discussion.....	99

4.4.1 Enthalpy of mixing.....	99
4.4.2 Theoretical Modeling.....	109
Chapter-5: Calorimetric measurement of Bi-In-Sn system.....	(121-146)
5.1 Introduction.....	121
5.2 Literature review.....	123
5.3 Experimental.....	126
5.3.1 Materials.....	126
5.4 Results and discussion.....	129
5.5 Iso-enthalpy curves for the integral enthalpy of mixing.....	141
5.6 Theoretical Modeling.....	144
Chapter-6: Conclusions.....	(147-149)
6.1 Overall conclusions.....	147
Scope for future work.....	151
References.....	(153-171)
List of Publications.....	173