

CONTENTS

List of Figures	i
List of Tables	vi
List of Publications	vi

Chapter 1 INTRODUCTION

1.1	Introduction	1
1.2	Metallic Glasses & Bulk Metallic Glasses	2
1.2.1	History of Metallic Glasses	4
1.2.2	Properties of Amorphous Alloys	6
1.2.3	Applications of MG's and BMG's	7
1.3	Glass Forming Ability (GFA) of Metallic Glasses	11
1.4	Time-Temperature-Transformation (TTT) diagram of Metallic Glass	14
1.5	Crystallization Kinetics of Metallic Glass	15
	References	17

Chapter 2 EXPERIMENTAL TECHNIQUE

2.1	Introduction	19
2.2	Instrumentation Basics	21
2.3	Measurement of Enthalpy Difference in DSC	23
2.4	Experimental	24
	References	28

Chapter 3 GLASS FORMING ABILITY (GFA) OF METALLIC GLASSES

3.1	Introduction	29
3.2	Different GFA Parameters	30
3.3	Thermodynamics of Metallic Glasses	31
3.4	Different expressions of ΔG and ΔS	33
3.5	Results and Discussion	38
3.5.1	Gibbs free energy difference for different multicomponent amorphous alloys.	38
3.5.2	Calculation of GFA parameters for different multicomponent amorphous alloys.	42

3.5.3	Regression analysis	43
3.5.4	Glass forming ability of Mg-Ni-Pr based metallic glasses.	49
3.5.5	Glass forming ability and Thermal Stability of Cu-Pr Based Metallic Alloys	54
3.6	Conclusions	57
	References	60

Chapter 4 TIME-TEMPERATURE-TRANSFORMATION (TTT) DIAGRAM OF METALLIC GLASS

4.1	Introduction	63
4.2	Theoretical formulation	67
4.2.1	Expressions for Nucleation and growth	67
4.2.2	Estimation of Gibbs free energy difference	68
4.2.3	Estimation of Critical cooling rate (R_c) using TTT curves	70
4.2.4	Expression for mixing enthalpy and entropy for multicomponent amorphous alloys	71
4.3	Results and Discussion	72
4.3.1	Determination of ΔG using different theoretical models	72
4.3.2	Glass forming ability of different Pd based metallic glasses	78
4.3.3	Effect of different model of ΔG in calculation of R_c for Pd based systems	80
4.3.4	Estimation of Critical Cooling Rate for binary metallic glasses using TTT Diagram	86
4.3.4.1	Gibbs free energy difference and TTT curves for binary metallic glasses	86
4.3.4.2	Estimation of Critical size from R_c for binary alloys	90
4.4	Conclusions	92
	References	94

Chapter 5 CRYSTALLIZATION KINETICS OF METALLIC GLASS

5.1	Introduction	97
5.2	Theoretical Formulations	99
5.2.1	Theory of Phase Transformation	99
5.2.2	Iso-conversional Methods	100
5.2.2.1	Linear Integral Isoconversional Methods	101
5.2.2.2	Linear Differential Isoconversional Methods	104

5.2.3	Iso-kinetic Methods	105
5.2.4	Testing Techniques	107
5.2.4.1	Malek test	107
5.2.4.2	Master Plot method	109
5.2.4.3	Normalized Heat Flow Curves	110
5.3	Results and Discussion	110
5.3.1	Crystallization kinetics of Zr based metallic glass	110
5.3.2	Testing techniques to check the validation of different methods	113
5.3.3	Iso-conversional Methods	121
5.3.3.1	Linear integral iso-conversional methods	121
5.3.3.2	Linear differential iso-conversional methods	126
5.3.4	Isokinetic Methods	129
5.3.5	Effect of heating rate on primary and secondary crystallization processes	132
5.4	Conclusions	134
	References	136
Chapter 6	CONCLUSION	142
6.1	Scope for future work	145