Content

Chapter 1 Introduction	1
1.1 Current energy society	1
1.2 Hydrogen in energy systems	2
1.3 Hydrogen storage	4
1.4 Motivation and outline	7
Chapter 2 Theory of solid state hydrogen storage and model develop	ment I
2.1 Classification of solid hydrogen storage materials	10
2.2 Metal hydrides	11
2.2.1 The Lennard-Jones Potential curve	11
2.2.2 Sorption mechanism and thermodynamics	13
2.2.3 Surface reactions	15
2.2.4 Magnesium hydride	17
2.2.5 Sodium alanate	18
2.3 Evaluation of hydrogen storage capacity	20
2.3.1 Static volumetric principle	20
2.3.2 Thermogravimetry	21
2.4 Modelling	22
2.4.1 Background of modelling	22
2.4.2 Chou's model	25
2.4.3 Introduction of own model for hydrogen sorption	27
Chapter 3 Experimental methods	30
3.1 Suspension production and characterization	30
3.1.1 Mechanical alloying and mechanical milling	30
3.1.1.1 Types of mills	31
3.1.1.2 Milling variables	35
3.1.2 Suspension production	38
3.1.3 Viscosity measurement	40
3.1.4 Particle size measurement	42

	42
3.2 Powder production and characterization	
3.2.1 Powder Production	
3.2.2 X-Ray Diffraction (XRD)	43
3.2.3 Scanning Electron Microscopy (SEM)	45
3.2.4 Specific surface area measurement (BET measurement)	45
3.3 Sorption test and characterization	46
Chapter 4 Experimental results and discussion	49
4.1 Improvement of MgH ₂ properties	49
4.1.1 Improvement of MgH ₂ properties due to processing	49
4.1.1.1 Characteristics of MgH ₂ suspension	49
4.1.1.2 Characteristics of MgH ₂ powder	53
4.1.1.3 Sorption behaviour of MgH ₂ powder	57
4.1.1.4 Sorption cycling behaviour of MgH ₂ powder	62
4.1.1.5 P-C-T curves and Van't Hoff plot	65
4.1.2 Improvement of MgH ₂ properties due to catalysts	67
4.1.2.1 Microstructure modification of wet ball milled MgH_2 with	
catalysts	67
4.1.2.3 Improvement of sorption behaviour due to catalysts	73
4.1.2.4 Improvement of cycling behaviour due to catalysts	81
4.1.2.5 Thermodynamics of wet ball milled MgH2 with catalysts	84
4.1.2.6 Further improvement of the milling conditions for wet ball mi	illed
MgH ₂ powder with Nb ₂ O ₅ catalyst	86
4.2 Comparison of results with literature values	90
4.3 Mechanism of hydrogen desorption of wet ball milled MgH2 powder	94
4.3.1 Typical features of hydrogen desorption behaviour of wet ball mil	led
MgH ₂ powder	95
4.3.2 Build up the modelling and the corresponding modelling results	95
4.4 Hydrogen sorption of NaAlH4	109
Chapter 5 Summary of the conclusions	111
Reference	114