

Contents

1	Introduction	1
1.1	Hydrogen Energy and Hydrogen Storage Materials	1
1.1.1	The Significance of Hydrogen Energy	1
1.1.2	Characteristics and Research Status of Hydrogen Energy	3
1.1.3	Research Progress of Hydrogen Storage Materials	4
1.1.4	Research Progress of Mg-Based Hydrogen Storage Materials	8
1.2	Hydrogen Storage Properties of Mg-Based Films	23
1.2.1	Preparation and Characterization of Mg-Based Films	24
1.2.2	Research Progress of Mg-Based Hydrogen Storage Films	24
1.3	Hydrogen-Induced Property Changes of Thin Films and the Applications	27
1.4	Contents of This Thesis	29
	References	32
2	Experimental Methods	41
2.1	Film Preparation	41
2.2	Thin Film Characterization	42
2.2.1	X-Ray Diffraction	42
2.2.2	Scanning Electron Microscope/Energy Dispersive Spectrum Analysis (SEM/EDS)	42
2.2.3	Transmission Electron Microscopy (TEM)	43
2.3	Property Measurements of Thin Films	43
2.3.1	Electrical Resistance Measurements	43
2.3.2	Optical Transmittance Measurements	44
2.3.3	Electrochemical Property Measurements	45
	References	46

3	Structural Tailoring of Mg-Based Thin Films and Study of Their Hydrogen Storage Properties.	47
3.1	Introduction	47
3.2	Experimental.	48
3.2.1	Film Preparation	48
3.2.2	Structural Characterization and Property Measurements	48
3.3	Results and Discussion.	49
3.3.1	Gaseous Hydrogen Storage Properties	49
3.3.2	Electrochemical Hydrogen Storage Properties	55
3.3.3	Discussions.	57
3.4	Conclusions	58
	References	58
4	Hydrogen Storage Properties of Mg-Based Thin Films with Different Interlayers	61
4.1	Introduction	61
4.2	Experimental.	62
4.2.1	Film Preparation	62
4.2.2	Structural Characterization	62
4.3	Results and Discussion.	63
4.3.1	Hydrogen Storage Properties of Mg–Ti–Pd Films	63
4.3.2	Hydrogen Storage Properties of Mg–Al–Pd Films	70
4.3.3	Mechanism and Discussion.	75
4.4	Conclusions	79
	References	79
5	Gaseous and Electrochemical Hydrogen Storage Properties of Mg–Ti Multilayers	81
5.1	Introduction	81
5.2	Experimental.	82
5.2.1	Film Preparation	82
5.2.2	Structural Characterization	82
5.3	Results and Discussion.	83
5.3.1	Gaseous Hydrogen Storage Properties	83
5.3.2	Electrochemical Properties	90
5.4	Conclusions	95
	References	95
6	Effects of Different Mg/Ti Ratios on the Electrochemical Hydrogen Storage Properties of Mg_xTi_{1-x}–Pd Films	97
6.1	Introduction	97
6.2	Experimental.	98
6.2.1	Film Preparation	98
6.2.2	Structural Characterization and Electrochemical Measurements.	98

6.3	Results and Discussion	98
6.3.1	Structural Characterization	98
6.3.2	Electrochemical Properties	99
6.3.3	Mechanism of Electrochemical Hydrogen Storage	102
6.4	Conclusion	104
	References	104
7	Conclusions and Outlook	107
7.1	Conclusions	107
7.2	Outlook	108