

# Contents

<b>Foreword</b> . . . . .	ix
Philippe MARTY	
<b>Chapter 1. Materials for Thermochemical and Sorption Heat Storage</b> . . . . .	1
Kokouvi Edem N'TSOUKPOE	
1.1. Introduction . . . . .	1
1.2. Definitions and key concepts . . . . .	4
1.3. Material selection criteria and review of important characteristics for a thermochemical heat storage material. . . . .	8
1.3.1. Selection and overview of key material properties by application . . . . .	8
1.3.2. Important considerations about certain characteristics and selection criteria for thermochemical heat storage materials . . . . .	10
1.4. Description of the thermodynamic equilibrium of sorption materials . . . . .	15
1.4.1. The case of chemisorption . . . . .	15
1.4.2. The case of physisorption. . . . .	18
1.5. Overview of the main materials studied in the context of thermochemical energy storage . . . . .	25
1.5.1. Sorbates . . . . .	25
1.5.2. Sorption pairs . . . . .	26

1.6. Introduction to the issue of heat and mass transfer in solid–gas storage materials . . . . .	55
1.6.1. Kinetics of the adsorption phenomenon or solid–gas reaction . . . . .	55
1.6.2. Improvements to the characteristics of thermochemical heat storage materials. . . . .	60
1.7. Overview of material characterization for thermochemical heat storage applications . . . . .	66
1.7.1. Determination of thermodynamic equilibrium conditions . . . . .	66
1.7.2. Determination of enthalpies . . . . .	74
1.8. References . . . . .	77
<b>Chapter 2. Heat Storage Using Absorption Processes . . . . .</b>	<b>95</b>
Nolwenn LE PIERRÈS	
2.1. Absorption processes: the principle . . . . .	96
2.1.1. AHPs . . . . .	96
2.1.2. Components of the one-stage AHP cycle. . . . .	98
2.1.3. Operating conditions of AHPs . . . . .	100
2.2. Methods for storing heat by absorption . . . . .	103
2.2.1. Design of a system for storing heat by absorption . . . . .	103
2.2.2. Operating conditions . . . . .	108
2.2.3. Performance indicators . . . . .	111
2.3. Reactors . . . . .	114
2.3.1. Absorption reactors using tubes . . . . .	117
2.3.2. Absorption reactors using plates . . . . .	119
2.4. Intensified storage cycles . . . . .	120
2.4.1. Intensification through the crystallization of the solution. . . . .	121
2.4.2. Intensification through modifying the cycle: two-stage cycles . . . . .	124
2.5. Integration of absorption storage systems: case studies . . . . .	131
2.5.1. Integration of absorption heat storage systems in solar buildings . . . . .	132
2.5.2. Integration of absorption heat storage systems into a decentralized microgrid . . . . .	135
2.6. Conclusion . . . . .	137
2.7. References . . . . .	138

---

**Chapter 3. Heat Storage Using Adsorption Processes . . . . . 143**

Larysa RATEL, Kevyn JOHANNES and Frédéric KUZNIK

3.1. Introduction . . . . .	143
3.2. Overview of heat storage by adsorption . . . . .	144
3.2.1. Principle of the operation of adsorption materials . . . . .	144
3.2.2. Classification of systems . . . . .	145
3.2.3. Integration of storage systems in buildings . . . . .	156
3.3. Existing prototypes of sorption heat storage . . . . .	160
3.3.1. Closed systems . . . . .	160
3.3.2. Open systems . . . . .	165
3.4. System performances: an analysis of the prototypes presented . . . . .	176
3.5. The influence of kinetics . . . . .	179
3.6. Real-scale systems . . . . .	182
3.7. Conclusion . . . . .	184
3.8. References . . . . .	185

**Chapter 4. Heat Storage by Chemical Sorption Processes . . . . . 195**

Antoine PERRIGOT, Driss STITOU and Maxime PERIER-MUZET

4.1. Introduction . . . . .	195
4.2. History of chemical sorption systems . . . . .	196
4.3. Principles of the operation of thermochemical systems . . . . .	197
4.3.1. The phenomenon of chemical sorption and reagents . . . . .	198
4.3.2. Thermochemical reactor . . . . .	203
4.3.3. Typical method for thermochemical storage . . . . .	207
4.4. Advanced thermochemical processes . . . . .	219
4.4.1. Heat recovery cycles . . . . .	219
4.4.2. Mass recovery cycles . . . . .	221
4.4.3. Multi-effect thermochemical processes in thermal cascades . . . . .	221
4.4.4. Hybrid thermal/mechanical cycles . . . . .	222
4.5. Diversification of applications with storage . . . . .	223
4.5.1. Heating . . . . .	223
4.5.2. Production of cold . . . . .	225
4.5.3. Simultaneous cold/heat/work generation . . . . .	226
4.5.4. Integration with a microgrid . . . . .	227

4.6. Conclusion . . . . .	227
4.7. References . . . . .	227
<b>List of Authors . . . . .</b>	<b>233</b>
<b>Index . . . . .</b>	<b>235</b>
<b>Summary of Volume 1 . . . . .</b>	<b>241</b>