

Contents

1. Introduction	1
2. Thermodynamics of the Interaction of Hydrogen Isotopes with Metals and Intermetallic Compounds	3
2.1 Theory of Phase Equilibrium in Hydrogen–Metal Systems	3
2.2 Phase Equilibrium in Heavy Hydrogen Isotope–Metal (IMC) Systems	6
2.3 Equilibrium Calorimetric Method for Studying Hydrogen–Me(IMC) Systems	12
3. Isotope Equilibrium of Hydrogen with Hydride Phases (Thermodynamic Isotope Effect)	26
3.1 Thermodynamic Isotope Effect and Its Connection with Phase Equilibrium	26
3.2 Experimental Methods for Investigating Isotope Equilibrium	29
3.3 Calculation of Separation Factors by the Harmonic Oscillator Model. Positive and Negative Isotope Effects	34
3.4 Dependence of the Separation Factor on Isotope Concentration ..	44
3.5 Relation of Separation Factors to the Nature of Hydrides of Metals and Intermetallic Compounds	49
3.5.1 Influence of the Geometrical Factor on α in Hydrogen–Metal-Hydride Systems	51
3.5.2 Dependence of the Separation Factor on the Electronic Structure of Metals and IMC	59
3.6 Dependence of Separation Factors on Temperature and Pressure ..	65
3.6.1 Temperature Dependence of α in the H ₂ –Pd(β -phase) System	66
3.6.2 Temperature Dependence of α in the Systems H ₂ –UH ₃ and H ₂ –TiMn _{1.5} H _{2.5}	70
3.6.3 Dependence of α on Pressure; Hydrogen Concentration in the Solid Phase	72
3.7 Interrelation Between Isotope Effects in H–T, H–D, and D–T Mixtures and Distribution of Tritium in Three-Isotope Mixtures H–D–T Between Equilibrium Phases ..	74

4. Kinetics of Hydrogen Isotope Interaction with Hydride Phases	78
4.1 Equation of Formal Kinetics	78
4.2 Mass-Transfer of Hydrogen in Systems with Hydride Phases	82
4.3 Experimental Methods for Studying the Kinetics of Hydrogen Isotope Interaction with Hydride Phases	86
4.4 Dependence of the Isotope Exchange Rate on the Number of Hydrogenation–Dehydrogenation Cycles During the Metal and IMC Activation Process	91
4.5 Influence of Polydispersity of Metal and IMC Samples on the Kinetics of Hydrogen Isotope Exchange	95
4.6 Influence of Temperature and Pressure on Isotope Exchange Kinetics	99
4.7 Hydrogen Isotope Exchange on Granulated Sorbents	106
4.7.1 Preparation of Granulated Sorbents	106
4.7.2 Experimental Data of Hydrogen Isotope Exchange on Granulated Sorbents	107
5. The Use of H₂–Me(IMC) Systems for Hydrogen Isotope Separation	113
5.1 Periodic Separation Processes	113
5.2 Continuous Counter-Current Separation Processes	120
5.2.1 Hypersorption	121
5.2.2 Sectioned Column	123
5.2.3 Two-Temperature Method	129
5.2.4 Optimum Conditions for separation	133
5.3 Use of Systems with a Hydride Phase for Practical Separation of Tritium-Containing Isotope Mixtures	138
References	145
List of Symbols	155
List of Materials	159
Subject Index	161

