

Contents

1	Introduction	1
1.1	Introduction	1
1.2	Emerging Memory Technologies	2
1.3	Phase-change Memory	3
1.3.1	Principle	3
1.3.2	Phase-change Materials	4
1.3.3	Phase-change Mechanism	5
1.4	Goal and Structure of the Thesis	12
	References	13
2	Component Optimization of Sb–Te for Ti–Sb–Te Alloy	15
2.1	Ti-Doped Sb ₂ Te Alloy	15
2.1.1	Introduction	15
2.1.2	Experimental Section	17
2.1.3	Thermal Stability	17
2.1.4	Crystalline Structure	18
2.1.5	Device Performance	19
2.1.6	Summary	21
2.2	Ti-Doped Sb ₄ Te Alloy	21
2.2.1	Introduction	21
2.2.2	Experimental Section	22
2.2.3	Thermal Stability	23
2.2.4	Crystalline Structure	24
2.2.5	Device Performance	27
2.2.6	Summary	29
2.3	Ti-Doped Sb ₂ Te ₃ Alloy	30
2.3.1	Introduction	30
2.3.2	Experimental Section	30
2.3.3	Thermal Stability	30

2.3.4	Crystalline Structure	33
2.3.5	Device Performance	35
2.3.6	Summary.	37
2.4	Conclusion	38
	References.	38
3	Component Optimization of Ti for Ti–Sb–Te Alloy	41
3.1	Introduction	41
3.2	Experimental Section	41
3.3	Sheet Resistance–Temperature Characteristics	42
3.4	Density Changes upon Crystallization	44
3.5	Thermal Conductivities.	48
3.6	Crystalline Structures	49
3.7	Device Performances	54
3.8	Conclusion	57
	References.	58
4	Crystallization Behavior of Ti–Sb–Te Alloy	59
4.1	Introduction	59
4.2	Experimental Section	60
4.3	Time-Dependent Morphology Evolution.	62
4.4	Real-Time Radial Distribution Function	64
4.5	Ab Initio Molecular Dynamics Simulations	68
4.6	Crystallization Speed	70
4.7	Conclusion	72
	References.	73
5	Material and Device Performances of Optimized Ti–Sb–Te Alloy	75
5.1	Introduction	75
5.2	Experimental Section	76
5.3	Melting Point	77
5.4	Reset Current and Power	77
5.5	Concentration Distribution	79
5.6	Reset Speed	79
5.7	Resistance Drift	80
5.8	Elevated Temperature Operation.	81
5.9	Conclusion	84
	References.	84
6	Phase Change Mechanism of Ti–Sb–Te Alloy.	87
6.1	Introduction	87
6.2	Calculation and Experiment Section	87

6.3	Crystalline Structure	88
6.3.1	Studied by First Principle Calculation	88
6.3.2	Studied by Transmission Electron Microscopy	90
6.4	Phase Change Mechanisam.	97
6.5	Conclusion	100
	References.	101
7	Atom Probe Tomography Study of Optimized	
	Ti–Sb–Te Alloy	103
7.1	Introduction	103
7.2	Experimental Section	104
7.3	Mass Spectrum	106
7.4	Three-Dimensional Mapping.	107
7.5	Conclusion	110
	References.	111
8	Ti–Sb–Te-Based Phase Change Memory Chip	113
8.1	Introduction	113
8.2	Experimental Section	114
8.3	Component Adjustment	115
8.4	Adhesion Strength	116
8.5	Diffusion.	117
8.6	Thermal Stability	118
8.7	12-Inch PCM Chip	120
8.8	Conclusion	123
	References.	124

Ti-Sb-Te Phase Change Materials: Component
Optimisation, Mechanism and Applications

Zhu, M.

2017, XVI, 124 p. 83 illus., Hardcover

ISBN: 978-981-10-4381-9