

MICROSTRUCTURE EVOLUTION IN CU-BASED ALLOYS AS FUNCTION OF EXTERNALLY APPLIED FORCES

MASTERARBEIT
zur Erlangung des akademischen Grades
MASTER OF SCIENCE

Westfälische Wilhelms-Universität Münster
Fachbereich Physik
Institut für Materialphysik

Prüfer:
Prof. Dr. Gerhard Wilde
PD Dr. Sergiy Divinskiy

Eingereicht von:
Regina Post

Münster, 29. September 2017

Contents

1	Introduction	1
2	Theoretical Background	2
2.1	Crystal structure	2
2.1.1	Defects	2
2.2	Heat treatment	4
2.2.1	Relaxation processes	4
2.2.2	Presentation mechanism	5
2.3	Magnetic driving force	7
2.4	Magnetism	8
3	Experimental methods	10
3.1	Sample preparation and polishing	10
3.2	The observed system: <i>CuBeNi</i>	10
3.3	Scanning electron microscope	12
3.3.1	Secondary and back scattered electron analysis	12
3.3.2	Energy dispersive characteristic X-ray detection	13
3.3.3	Electron backscatter diffraction	14
3.4	Physical properties measurement system	15
4	Results	16
4.1	Large scale microstructure	16
4.1.1	Measurements on as cast sample	16
4.1.2	Grain size of aged samples	17
4.1.3	Grain boundary morphology	19
4.1.3.1	Quantitative analysis of the SS/DS-mechanism	21
4.1.3.2	Structure evolution of the SS/DS-morphology with temperature	21
4.2	Close up microstructure	22
4.2.1	Nickel segregation and precipitation	22
4.2.2	BSE analysis	25
4.2.2.1	Precipitation mechanism in <i>CuBe</i>	26
4.2.2.2	Comparison of discontinuous precipitation	26
4.2.2.3	Discontinuous coarsening	30
4.2.2.4	Quantitative DP analysis	31
4.2.2.5	Special DP _{3J} -sites	33
4.3	Analysis of the <i>Ni</i> -precipitates	34
4.4	EDX-analysis of the different areas	35
4.4.1	Limenting factors	35
4.4.2	Compositional overview via EDX linescans	36
4.4.3	Overall composition	39
4.5	Magnetic properties	39
4.5.1	Response to a changing external magnetic field	39

4.5.2	Magnetization with changing temperature	42
5	Discussion	45
5.1	Observed temperature dependence	45
5.2	Comparison of DP_{3J} and DP_{DS}	45
5.3	The overall influence of the magnetic field	47
5.4	PPMS measurements	48
6	Summary	50
7	Appendix	51