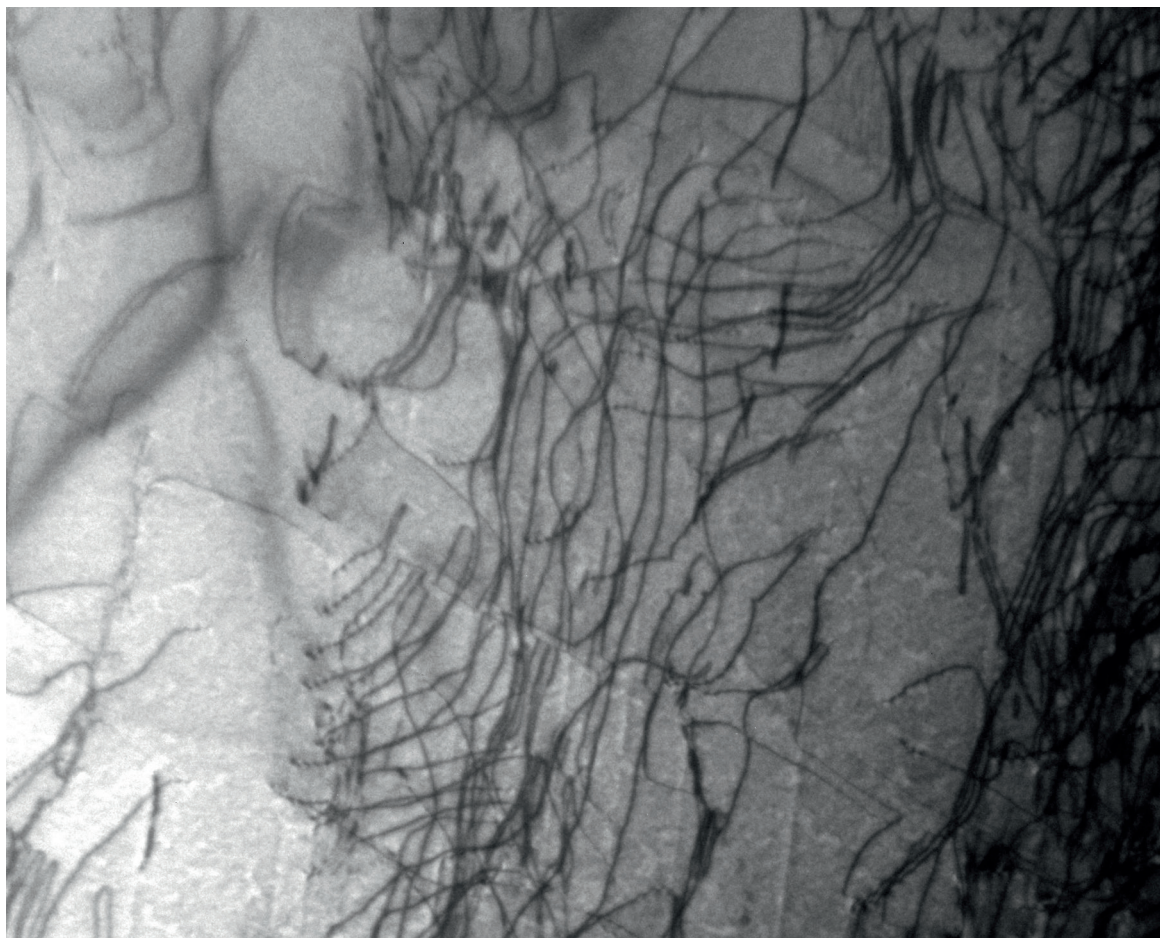




Characteristics of plastically deformed *fcc* and *bcc* High-Entropy Alloys

Tim Meenen

Information

Band / Volume 111

ISBN 978-3-95806-820-9

Forschungszentrum Jülich GmbH
Ernst Ruska-Centrum für Mikroskopie und Spektroskopie mit Elektronen (ER-C)
Physik Nanoskaliger Systeme (ER-C-1)

Characteristics of plastically deformed *fcc* and *bcc* High-Entropy Alloys

Tim Meenen

Table of contents

1	Introduction	1
2	High-Entropy Alloys	5
2.1	Fundamentals of Multi-Component Alloys	5
2.2	The equiatomic CrMnFeCoNi High-Entropy Alloy	9
2.3	The equiatomic TiVZrNbHf High-Entropy Alloy	11
3	Crystal Growth and Characterisation	13
3.1	Crystal Growth Methods and Materials Preparation	13
3.1.1	Liquid-Solid Phase Transition in Crystal Growth	13
3.1.2	Cold Crucible Levitation Melting	14
3.1.3	Czochralski Growth	15
3.1.4	Bridgman Growth	16
3.1.5	Zone Melting	17
3.2	Fabrication of equiatomic CrMnFeCoNi	18
3.2.1	Growth of Single Crystals	19
3.2.2	Influence of the Withdrawal Rate	20
3.2.3	Characterisation and Reproducibility	22
3.2.4	Heat Treatment of as-grown CrMnFeCoNi Single Crystals	25
3.3	Fabrication of equiatomic TiVZrNbHf	27
3.3.1	Fabrication of Polycrystals	28
3.3.2	Characterisation and Reproducibility	30
4	Mechanical Properties of plastically deformed High-Entropy Alloys	33
4.1	Fundamentals of Plastic Deformation	33
4.1.1	Dislocations and Plasticity	33
4.1.2	Thermal Activation	37
4.1.3	Thermodynamics	39
4.1.4	Incremental Testing	41

4.2	Macroscopic Phenomena in Plastic Deformation	42
4.2.1	Yield Strength and Anomaly	42
4.2.2	Serrated Flow	43
4.3	Experimental Methods	46
4.3.1	Sample Preparation	46
4.3.2	Uniaxial Deformation Machine	46
4.3.3	Measurement Procedures	47
4.4	Results	49
4.4.1	Deformation of CrMnFeCoNi	49
4.4.2	Deformation of TiVZrNbHf	56
4.5	Discussion	62
4.5.1	Deformation of CrMnFeCoNi	62
4.5.2	Deformation of TiVZrNbHf	65
5	Microscopic Investigation of plastically deformed High-Entropy Alloys	71
5.1	Experimental Methods	71
5.1.1	Sample Preparation	71
5.1.2	Transmission Electron Microscopy	72
5.1.3	Fundamental Techniques	72
5.2	Results	74
5.2.1	Deformed CrMnFeCoNi Single Crystals	74
5.2.2	Deformed polycrystalline TiVZrNbHf	79
5.3	Discussion	85
5.3.1	Microstructure of deformed CrMnFeCoNi	86
5.3.2	Microstructure of deformed TiVZrNbHf	90
6	Conclusion and Outlook	93
6.1	Conclusion	93
6.2	Outlook	95
6.2.1	CrMnFeCoNi	95
6.2.2	TiVZrNbHf	96
	Bibliography	99
	List of figures	111
	List of tables	117

Information
Band / Volume 111
ISBN 978-3-95806-820-9