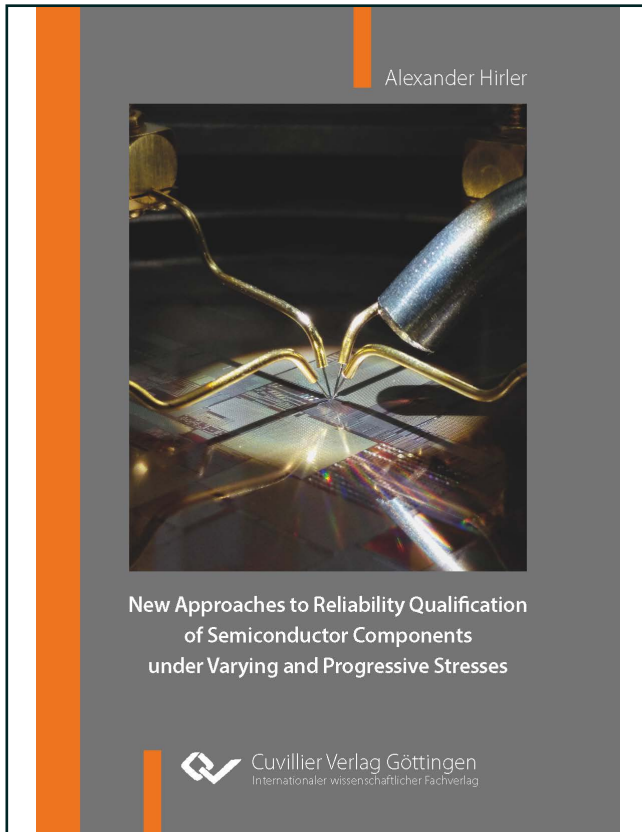




Alexander Hirler (Autor)
**New Approaches to Reliability Qualification of
Semiconductor Components under Varying and
Progressive Stresses**



<https://cuvillier.de/de/shop/publications/8542>

Copyright:

Cuvillier Verlag, Inhaberin Annette Jentzsch-Cuvillier, Nonnenstieg 8, 37075 Göttingen,
Germany

Telefon: +49 (0)551 54724-0, E-Mail: info@cuvillier.de, Website: <https://cuvillier.de>

Contents

1	Introduction	1
2	Theory of Reliability Testing	3
2.1	Statistical Description of Failures	3
2.1.1	Basic Concepts of Failure Statistics	3
2.1.2	The Bathtub Curve	6
2.1.3	Failure Distributions	7
2.1.4	Visualization and Analysis	11
2.2	Reliability Methodology	27
2.2.1	Reliability Testing and Lifetime Predictions	27
2.2.2	Accelerated Lifetime Testing	29
2.2.3	Data Analysis and Evaluation	33
3	The Failure Mechanism of Time-Dependent Dielectric Breakdown	37
3.1	Physics of Dielectric Breakdown	37
3.2	Test Structures, Devices and Methodology	40
3.3	Failure Acceleration	46
4	Effective Stressors	61
4.1	Mission Profiles	61
4.2	Cumulative Damage Models	63
4.2.1	Cumulative Exposure Model	63
4.2.2	Tampered Random Variable Model	65
4.2.3	Tampered Failure Rate Model	67
4.2.4	Experimental Validation of Cumulative Damage Behavior	70
4.2.5	Model Comparison	74
4.3	Mission Profile Stress and Effective Stressors	78
4.3.1	Transformation of Step-Stress into Effective Stress	80
4.3.2	Experimental Validation of the Effective Stress Transformation	82

4.4	Multi-Dimensional Mission Profiles with Interdependent Stressors . . .	90
4.4.1	Multi-Dimensional Acceleration Factors	91
4.4.2	Inferences from Interdependent Stressors	95
4.5	Technology Black Box	98
5	Elaborated Life-Testing with Ramp-Stress Tests	101
5.1	Ramp Measurement Methodology	102
5.2	Effective Stress Times	104
5.3	Validation of Stress-Equivalence	115
5.4	Model Fitting with Ramp Tests	118
6	Conclusion and Outlook	123
A	Appendix	127
A.1	Auxiliary Transformations and Scalings of the Weibull Distribution . .	127
A.2	Calculation Example for Multi-Dimensional Mission Profiles	128
A.3	Process Plans of TDDDB Test Devices	130
	List of Abbreviations	135
	Bibliography	137
	Publications	147
	Acknowledgments	151