

1. Record Nr.	UNINA9910254607103321
Autore	Bartolf Holger
Titolo	Fluctuation Mechanisms in Superconductors : Nanowire Single-Photon Counters, Enabled by Effective Top-Down Manufacturing // by Holger Bartolf
Pubbl/distr/stampa	Wiesbaden : , : Springer Fachmedien Wiesbaden : , : Imprint : Springer Spektrum, , 2016
ISBN	3-658-12246-3
Edizione	[1st ed. 2016.]
Descrizione fisica	1 online resource (336 p.)
Disciplina	530
Soggetti	Mathematical physics Nanotechnology Theoretical, Mathematical and Computational Physics
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Note generali	Description based upon print version of record.
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Preface - Vortex-Fluctuation and Single-Photon Detection with a Nanowire; Physical Background; Personal Remarks; The Scope and Organization of this Book; Acknowledgment, Motivation and Funding; References; Contents; Chapter 1 Introduction; 1.1 Quantum Nature and its Detection; 1.1.1 Thermal Detectors; 1.1.2 Ionization Detectors; 1.2 Cryogenic Quantum Detectors at the Beginning of the 21st Century; 1.2.1 Transition-Edge Sensors TES; 1.2.2 Kinetic-Inductance Detectors KID; 1.2.3 Superconducting Tunnel Junction Detectors STJD; 1.2.4 Superconducting Nanowire Single-Photon Detectors SNSPD References Part I Nanoscale Manufacturing Process Developments; Chapter 2 Considerations for Nanoscale Manufacturing; Chapter 3 Superconducting Thin-Film Preparation; 3.1 DC-Magnetron Sputtering; 3.1.1 The Physics of a DC Plasma Discharge; 3.1.2 Magnetron Sputtering of NbN Thin Films; 3.1.3 Magnetron Sputtering of Additional Superconducting Films; 3.2 Electron-Beam Evaporation; References; Chapter 4 Nanoscale-Precise Coordinate System: Scalable, GDSII-Design; 4.1 Process Layers; 4.2 Structure References; References; Chapter 5 Thin-Film Structuring 5.1 Easy and Effective Nanoscaled Top-Down Manufacturing 5.2 Organic Resists; 5.2.1 Resist Properties; 5.2.2 Resist Fabrication: Spin Coating;

5.3 Microscale Fabrication: Contact Photolithography; 5.3.1 Principle of Photolithography; 5.3.2 Physical Limit of Contact Photolithography; 5.3.3 Perfect Contact Utilizing Newton's Interference Rings; 5.3.4 Additive and Subtractive Lithographic Pattern Transfer; 5.3.5 Alignment Structures; 5.3.6 Controlling the Undercut during Development; 5.3.7 Critical Dimensions & Resist Profile ; 5.4 Nanoscale Fabrication: Electron-Beam Lithography  
 5.4.1 The Electron-Matter Interaction 5.4.2 Discrete Beam-Deflection, Exposure Dose and Dynamic Effects; 5.4.3 Alignment of the Stage Relative to the Beam; 5.4.4 Clearing-Dose Determination (PMMA950 k); 5.4.5 PMMA950 k to Obtain a Lift-Off Profile: Critical Dimension 10nm; 5.4.6 Proximity Effect Model(s); 5.4.7 Simulated Proximity-Effect Correction; 5.4.8 Manufacturing in the Sub - 100nm Regime Without Correction for the Proximity Effect; 5.4.9 ZEP 520A Etch Protection Layer: Critical Dimension 60nm; 5.5 Symbiotic Optimization of the Nanolithography and RF-Plasma Etching  
 5.6 Reactive Ion Etching 5.6.1 Proper Operation of the Radio-Frequency Discharge; 5.6.2 Etching Rate Determination; 5.6.3 Etched Photolithographic Critical Dimensions; 5.7 The 50nm Scale Compared to the Bit-Pattern on a Compact-Disk; Appendix 5.1: Phenomenological Electron-Beam Proximity Effect; Appendix 5.2: CASINO: Monte Carlo Simulation of the Electron-Matter Interaction; References; Chapter 6 Device Manufacturing; 6.1 Fabrication Process Chains; 6.2 Postfabrication Procedures: Sawing & Wire Bonding; 6.3 Manufacturing Twenty Devices in One Run: Small Scale Production; References  
 Chapter 7 Proof of Principle of the Above Described Approach

---

## Sommario/riassunto

Holger Bartolf discusses state-of-the-art detection concepts based on superconducting nanotechnology as well as sophisticated analytical formulæ that model dissipative fluctuation-phenomena in superconducting nanowire single-photon detectors. Such knowledge is desirable for the development of advanced devices which are designed to possess an intrinsic robustness against vortex-fluctuations and it provides the perspective for honorable fundamental science in condensed matter physics. Especially the nanowire detector allows for ultra-low noise detection of signals with single-photon sensitivity and GHz repetition rates. Such devices have a huge potential for future technological impact and might enable unique applications (e.g. high rate interplanetary deep-space data links from Mars to Earth). Contents  
 Superconducting Single-Photon Detectors Nanotechnological Manufacturing; Scale: 10 Nanometer Berezinskii-Kosterlitz Thouless (BKT) Transition, Edge-Barrier, Phase Slips Target Groups Researchers and students of physics in the fields of single-photon devices, nanofabrication, nanophotonics, nanoelectronics and superconductivity Industrial practitioners with focus on nanotechnology and single-photon detectors About the Author Holger Bartolf studied Solid State Physics at the Universities of Karlsruhe and Zürich. In 2011 he relocated at the Swiss Corporate Research Center of a leading company in power and automation technologies where his current interests focus on the applied R&D of the next generation of power semiconductors.

---