

Bei Yu · David Z. Pan

Design for Manufacturability with Advanced Lithography



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Design For Manufacturability With Advanced Lithography

Bei Yu,David Z. Pan

Design For Manufacturability With Advanced Lithography:

Design for Manufacturability with Advanced Lithography Bei Yu, David Z. Pan, 2015-10-28 This book introduces readers to the most advanced research results on Design for Manufacturability DFM with multiple patterning lithography MPL and electron beam lithography EBL. The authors describe in detail a set of algorithms methodologies to resolve issues in modern design for manufacturability problems with advanced lithography. Unlike books that discuss DFM from the product level or physical manufacturing level this book describes DFM solutions from a circuit design level such that most of the critical problems can be formulated and solved through combinatorial algorithms

Design for Manufacturability Artur Balasinski, 2013-10-05 This book explains integrated circuit design for manufacturability DfM at the product level packaging applications and applies engineering DfM principles to the latest standards of product development at 22 nm technology nodes. It is a valuable guide for layout designers packaging engineers and quality engineers covering DfM development from 1D to 4D involving IC design flow setup best practices links to manufacturing and product definition for process technologies down to 22 nm node and product families including memories logic system on chip and system in package

Design for Manufacturing with Advanced Lithography Bei Yu, 2014 Shrinking the feature size of very large scale integrated circuits VLSI with advanced lithography has been a holy grail for the semiconductor industry. However the gap between manufacturing capability and the expectation of design performance becomes critically challenged in sub 16nm technology nodes. To bridge this gap design for manufacturing DFM is a must to co optimize both design and lithography process at the same time. DFM for advanced lithography could be defined very differently under different circumstances. In general progress in advanced lithography happens along three different directions 1 New patterning technique e g layout decomposition for different patterning techniques 2 New design methodology e g lithography aware standard cell design and physical design 3 New illumination system e g layout fracturing for EBL system stencil planning for EBL system. In this dissertation we present our research results on design for manufacturing DFM with multiple patterning lithography MPL and electron beam lithography EBL addressing these three DFM research directions in advanced lithography. For the research direction of new patterning technique we study the layout decomposition problems for different patterning technique and explore four important topics 1 layout decomposition for triple patterning 2 density balanced layout decomposition for triple patterning 3 layout decomposition for triple patterning with end cutting 4 layout decomposition for quadruple patterning and beyond. We present the proof that triple patterning layout decomposition is NP hard. Besides we propose a number of CAD optimization and integration techniques to solve different problems. For the research direction of new design methodology we will show the limitation of traditional design flow. That is ignoring triple patterning lithography TPL in early stages may limit the potential to resolve all the TPL conflicts. We propose a coherent framework including standard cell compliance and detailed placement to enable TPL friendly design. Considering TPL constraints during early design stages such as standard cell

compliance improves the layout decomposability With the pre coloring solutions of standard cells we present a TPL aware detailed placement where the layout decomposition and placement can be resolved simultaneously In addition we propose a linear dynamic programming to solve TPL aware detailed placement with maximum displacement which can achieve good trade off in terms of runtime and performance For the EBL illumination system we focus on two topics to improve the throughput of the whole EBL system 1 overlapping aware stencil planning under MCC system 2 L shape based layout fracturing for mask preparation With simulations and experiments we demonstrate the critical role and effectiveness of DFM techniques for the advanced lithography as the semiconductor industry marches forward in the deeper sub micron domain

SOC-Based Solutions in Emerging Application Domains Veena S. Chakravarthi,Shivananda R. Koteswar,2025-04-09

Working in the ever evolving field of smart chip design within an AI powered design environment the authors of this book draw on their experiences in successfully developing system on chip SoC solutions having grappled with the emerging design environment innovative tools domain specific challenges and major design decisions for SOC based solutions They present the first comprehensive guide to navigating the technical challenges of SOC based solutions in emerging application domains covering various design and development methodologies for system on chip solutions for emerging target applications When diligently applied the strategies and tactics presented can significantly shorten development timelines help avoid common pitfalls and improve the odds of success especially in AI powered smart EDA environments The book provides a detailed insight into SoC based solutions for various applications including artificial intelligence AI post quantum security feature enhancements 3D SOCs quantum SOCs photonic SOCs and SOC solutions for IoT high performance computing SOCs and processor based systems The coverage includes architecture exploration methods for targeted applications compute intensive SoCs lightweight SoCs for IOT applications advanced technology node solutions and solutions including hardware software co designs and software defined SoCs The strategies best applied in these highly advanced technology developments are discussed in a guest chapter by a practicing high technology strategist so innovators designers entrepreneurs product managers investors and executives may properly prepare their companies to succeed

Directed Self-assembly of Block Co-polymers for Nano-manufacturing Roel Gronheid,Paul Nealey,2015-07-17 The directed self assembly DSA method of patterning for microelectronics uses polymer phase separation to generate features of less than 20nm with the positions of self assembling materials externally guided into the desired pattern Directed self assembly of Block Co polymers for Nano manufacturing reviews the design production applications and future developments needed to facilitate the widespread adoption of this promising technology Beginning with a solid overview of the physics and chemistry of block copolymer BCP materials Part 1 covers the synthesis of new materials and new processing methods for DSA Part 2 then goes on to outline the key modelling and characterization principles of DSA reviewing templates and patterning using topographical and chemically modified surfaces line edge roughness and dimensional control x ray scattering for

characterization and nanoscale driven assembly Finally Part 3 discusses application areas and related issues for DSA in nano manufacturing including for basic logic circuit design the inverse DSA problem design decomposition and the modelling and analysis of large scale template self assembly manufacturing techniques Authoritative outlining of theoretical principles and modeling techniques to give a thorough introduction to the topic Discusses a broad range of practical applications for directed self assembly in nano manufacturing Highlights the importance of this technology to both the present and future of nano manufacturing by exploring its potential use in a range of fields

Handbook of Emerging Materials for

Semiconductor Industry Young Suh Song,Laxman Raju Thoutam,Shubam Tayal,Shiromani Balmukund Rahi,T. S. Arun Samuel,2024-05-31 The proposed book will be a one stop place for all the young material researchers to understand the recent and reliable material making process characterization and reliability test tools The proposed book is designed to provide basic knowledge to understand and analyse structure property relationship for reliable emerging material systems for next generation of semiconductor technologies The book is suggested to engineers and scientists across the world working on various new and novel materials for reliable semiconductor device applications The book is expected to serve as a reference guide for young scientists and engineers in the field of material science and electronic engineers to acquire latest state of art experimental and computational tools to encourage their research activities Since the scope of the book is generic the book can be referred by all the students of science and engineering students to create a common awareness about the latest material systems and state of art characterization tools that have been broadly utilized to study the physical and chemical properties of different material systems It introduces the readers to a wide variety of new emerging materials systems including their synthesis fabrication measurement reliability test modelling and simulations with in depth analysis of selective applications This book contains the state of art research updates in the various fields of semiconductor artificial intelligence AI bio sensor biotechnology with respect to reliable material research Therefore various students who are eager to get a job in semiconductor AI Autonomous car biotechnology are strongly recommended to read this book and learn about related state of art knowledge

Design for Manufacturability Through Design-process Integration Alfred Kwok-Kit Wong,Vivek K. Singh,2007 Proceedings of SPIE present the original research papers presented at SPIE conferences and other high quality conferences in the broad ranging fields of optics and photonics These books provide prompt access to the latest innovations in research and technology in their respective fields Proceedings of SPIE are among the most cited references in patent literature

Design and Process Integration for Microelectronic Manufacturing II [sic] Lars W. Liebmann,2004 Proceedings of SPIE present the original research papers presented at SPIE conferences and other high quality conferences in the broad ranging fields of optics and photonics These books provide prompt access to the latest innovations in research and technology in their respective fields Proceedings of SPIE are among the most cited references in patent literature

Stereolithography Paulo Jorge Bárto,2011-03-18 Stereolithography Materials Processes and

Applications will focus on recent advances in stereolithography covering aspects related to the most recent advances in the field in terms of fabrication processes two photon polymerization micro stereolithography infrared stereolithography and stereo thermal lithography materials novel resins hydrogels for medical applications and highly reinforced resins with ceramics and metals computer simulation and applications *Annual Symposium on Photomask Technology* ,2002

Design and Process Integration for Microelectronic Manufacturing ,2006 Metrology, Inspection, and Process Control for Microlithography ,1997 **Proceedings of the ... ACM Great Lakes Symposium on VLSI.** ,2007 *Optical Microlithography* ,2007 **Proceedings** ,2003 *Science Abstracts* ,1995 **Advanced Metallization for Devices and Circuits--science, Technology, and Manufacturability** S. P. Murarka,1994 *Advanced Interconnects and Chemical Mechanical Planarization for Micro- and Nanoelectronics: Volume 1249* J. W. Bartha,2010-10-05 The MRS Symposium Proceeding series is an internationally recognised reference suitable for researchers and practitioners Journal of Advanced Materials ,2003 **Journal of Micro/nanolithography, MEMS, and MOEMS** ,2008

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