

Fabrication Engineering Campbell

Additive manufacturing, which was first invented in France and then applied in the United States, is now 33 years old and represents a market of around 5 billion euros per year, with annual growth of between 20 and 30%. Today, additive manufacturing is experiencing a great amount of innovation in its processes, software, engineering and materials used. Its strength as a process has more recently allowed for the exploration of new niches, ranging from applications at nanometer and decameter scales, to others in mechanics and health. As a result, the limitations of the process have also begun to emerge, which include the quality of the tools, their cost of manufacture, the multi-material aspects, functionalities and surface conditions. Volume 2 of this series presents the current techniques, improvements and limits of additive manufacturing, providing an up-to-date review of this process.

While applications rapidly change one to the next in our commercialized world, fundamental principles behind those applications remain constant. So if one understands those principles

well enough and has ample experience in applying them, he or she will be able to develop a capacity for reaching results via conceptual thinking rather than having to

Now in its eleventh edition, DeGarmo's *Materials and Processes in Manufacturing* has been a market-leading text on manufacturing and manufacturing processes courses for more than fifty years. Authors J T. Black and Ron Kohser have continued this book's long and distinguished tradition of exceedingly clear presentation and highly practical approach to materials and processes, presenting mathematical models and analytical equations only when they enhance the basic understanding of the material. Completely revised and updated to reflect all current practices, standards, and materials, the eleventh edition has new coverage of additive manufacturing, lean engineering, and processes related to ceramics, polymers, and plastics.

Based on a popular article in *Laser and Photonics Reviews*, this book provides an explanation and overview of the techniques used to model, make, and measure metal nanoparticles, detailing results obtained and what they mean. It covers the properties of coupled

metal nanoparticles, the nonlinear optical response of metal nanoparticles, and the phenomena that arise when light-emitting materials are coupled to metal nanoparticles. It also provides an overview of key potential applications and offers explanations of computational and experimental techniques giving readers a solid grounding in the field.

Nanofluidics and Microfluidics

Growth and Transport in Nanostructured Materials

MEMS Materials and Processes Handbook

Processes and Design for Manufacturing, Third Edition

Fabrication Engineer

Chilton's Food Engineering

A revised guide to the theory and implementation of CMOS analog and digital IC design The fourth edition of CMOS: Circuit Design, Layout, and Simulation is an updated guide to the practical design of both analog and digital integrated circuits. The author—a noted expert on the topic—offers a contemporary review of a wide range of analog/digital circuit blocks including: phase-locked-loops, delta-sigma sensing circuits, voltage/current references, op-amps, the design of data converters, and switching power supplies. CMOS includes discussions that detail the trade-offs and considerations when designing at the transistor-level. The companion website contains numerous examples for many computer-aided design (CAD) tools. Using the website enables readers to recreate, modify, or simulate

the design examples presented throughout the book. In addition, the author includes hundreds of end-of-chapter problems to enhance understanding of the content presented. This newly revised edition:

- *Provides in-depth coverage of both analog and digital transistor-level design techniques*
- *Discusses the design of phase- and delay-locked loops, mixed-signal circuits, data converters, and circuit noise*
- *Explores real-world process parameters, design rules, and layout examples*
- *Contains a new chapter on Power Electronics*

Written for students in electrical and computer engineering and professionals in the field, the fourth edition of CMOS: Circuit Design, Layout, and Simulation is a practical guide to understanding analog and digital transistor-level design theory and techniques.

As device sizes in the semiconductor industries shrink, devices become more vulnerable to smaller contaminant particles, and most conventional cleaning techniques employed in the industry are not effective at smaller scales. The book series Developments in Surface Contamination and Cleaning as a whole provides an excellent source of information on these alternative cleaning techniques as well as methods for characterization and validation of surface contamination. Each volume has a particular topical focus, covering the key techniques and recent developments in the area. Several novel wet and dry surface cleaning methods are addressed in this Volume. Many of these methods have not been reviewed previously, or the previous reviews are dated. These methods are finding increasing commercial application and the information in this book will be of high value to the reader. Edited by the leading experts in small-scale particle surface contamination, cleaning and cleaning control these books will be an invaluable reference for researchers and engineers in R&D, manufacturing, quality control and procurement specification situated in a multitude of industries such as: aerospace, automotive, biomedical, defense, energy, manufacturing, microelectronics, optics and xerography. Provides a state-of-the-art survey and best-practice guidance for scientists and

engineers engaged in surface cleaning or handling the consequences of surface contamination Addresses the continuing trends of shrinking device size and contamination vulnerability in a range of industries, spearheaded by the semiconductor industry and others Covers novel wet and dry surface cleaning methods of increasing commercial importance

In the education area, Professor Campbell leads the University of Minnesota's participation in Nano-Link, an NSF sponsored regional center for nanotechnology education at the AAS level. He has designed and implemented a one-semester capstone experience Microelectronic Fabrication and created the text book as a result. Designed for advanced undergraduate or first-year graduate courses in semiconductor or microelectronic fabrication, this fourth edition of Fabrication Engineering at the Micro- and Nanoscale provides a thorough and accessible introduction to all fields of micro and nano fabrication. The text covers the entire basic unit processes used to fabricate integrated circuits and other devices.

Have you ever puzzled over how to perform Boolean logic at the atomic scale? Or wondered how you can carry out more general calculations in one single molecule or using a surface dangling bond atomic scale circuit? This volume gives you an update on the design of single molecule devices, such as rectifiers, switches and transistors, more advanced semi-classical and quantum boolean gates integrated in a single molecule or constructed atom by atom on a passivated semi-conductor surface and describes their interconnections with adapted nano-scale wiring. The main contributors to the field of single molecule logic gates and surface dangling bond atomic scale circuits theory and design, were brought together for the first time to contribute on topics such as molecule circuits, surface dangling bond circuits, quantum controlled logic gates and molecular qubits. Contributions in this volume originate from the Barcelona workshop of the AtMol conference series, held from January

12-13 2012.

Fabrication Engineering at the Micro- and Nanoscale

Outlines and Highlights for Fabrication Engineering at the Micro- and Nanoscale by Stephen a Campbell

Hearing Before the Subcommittee on Energy Development and Applications of the Committee on Science and Technology, U.S. House of Representatives, Ninety-sixth Congress, First Session, July 30, 1979

Reactive Transport in PVD, CVD, and ALD

Studyguide for Fabrication Engineering at the Micro- and Nanoscale by Campbell, Stephen A. Theory and Technology

Providing a definitive source of knowledge about the principles, materials, and process techniques used in the fabrication of microfluidics, this practical volume is a must for your reference shelf. The book focuses on fabrication, but also covers the basic purpose, benefits, and limitations of the fabricated structures as they are applied to microfluidic sensor and actuator functions. You find guidance on rapidly assessing options and tradeoffs for the selection of a fabrication method with clear tabulated process comparisons.

Now in its third edition, Fundamentals of Microfabrication and Nanotechnology continues to provide the most complete MEMS coverage available. Thoroughly revised and updated the new edition of this perennial bestseller has been expanded to three volumes, reflecting the substantial growth of this field. It includes a wealth of theoretical and practical information on nanotechnology and

NEMS and offers background and comprehensive information on materials, processes, and manufacturing options. The first volume offers a rigorous theoretical treatment of micro- and nanosciences, and includes sections on solid-state physics, quantum mechanics, crystallography, and fluidics. The second volume presents a very large set of manufacturing techniques for micro- and nanofabrication and covers different forms of lithography, material removal processes, and additive technologies. The third volume focuses on manufacturing techniques and applications of Bio-MEMS and Bio-NEMS. Illustrated in color throughout, this seminal work is a cogent instructional text, providing classroom and self-learners with worked-out examples and end-of-chapter problems. The author characterizes and defines major research areas and illustrates them with examples pulled from the most recent literature and from his own work. Ideal for upper-level undergraduate or first-year graduate courses and as a handy reference for professionals, *The Science and Engineering of Microelectronic Fabrication, Second Edition*, provides a thorough and accessible introduction to the field of microfabrication. Revised and expanded in this second edition, the text covers all the basic unit processes used to fabricate integrated circuits, including photolithography, plasma and reactive ion etching, ion implantation, diffusion, oxidation, evaporation, vapor phase epitaxial growth, sputtering, and chemical vapor deposition. Advanced processing topics such as rapid thermal processing, next generation lithography, molecular beam epitaxy, and metal organic chemical vapor deposition are also presented. The physics and chemistry of each process is

introduced along with descriptions of the equipment used for the manufacture of integrated circuits. The text also discusses the integration of these processes into common technologies such as CMOS, double poly bipolar, and GaAs MESFETs. Complexity/performance tradeoffs are evaluated along with a description of current state-of-the-art devices. Each chapter includes sample problems with solutions. The text makes use of the popular process simulation package SUPREM to provide more meaningful examples of the type of real-world dopant redistribution problems that microelectronic fabrication engineers must face. This new edition includes a chapter on microelectromechanical structures (MEMS), an exciting new area in microfabrication. The coverage of MEMS includes fundamentals of mechanics; stress in thin films; mechanical to electrical transduction; mechanics of common MEMS devices; bulk micromachining etching techniques; bulk micromachining process flow; surface micromachining basics; surface micromachining process flow; MEMS actuators; and high aspect ratio microsystems technology (HARMST).

This book discusses modern-day Metal Oxide Semiconductor Field Effect Transistors (MOSFETs) and future trends of transistor devices. This book provides an overview of Field Effect Transistors (FETs) by discussing the basic principles of FETs and exploring the latest technological developments in the field. It covers and connects a wide spectrum of topics related to semiconductor device physics, physics of transistors, and advanced transistor concepts. This book contains six chapters. Chapter 1 discusses electronic materials and charge. Chapter 2 examines

junctions, discusses contacts under thermal-equilibrium, metal-semiconductor contacts, and metal-insulator-semiconductor systems. Chapter 3 covers traditional planar Metal Oxide Semiconductor Field Effect Transistors (MOSFETs). Chapter 4 describes scaling-driving technological variations and novel dimensions of MOSFETs. Chapter 5 analyzes Heterojunction Field Effect Transistors (FETs) and also discusses the challenges and rewards of heteroepitaxy. Finally, Chapter 6 examines FETs at molecular scales. Links the discussion of contemporary transistor devices to physical processes Material has been class-tested in undergraduate and graduate courses on the design of integrated circuit components taught by the author Contains examples and end-of-chapter problems Field Effect Transistors, A Comprehensive Overview: From Basic Concepts to Novel Technologies is a reference for senior undergraduate / graduate students and professional engineers needing insight into physics of operation of modern FETs. Pouya Valizadeh is Associate Professor in the Department of Electrical and Computer Engineering at Concordia University in Quebec, Canada. He received B.S. and M.S. degrees with honors from the University of Tehran and Ph.D. degree from The University of Michigan (Ann Arbor) all in Electrical Engineering in 1997, 1999, and 2005, respectively. Over the past decade, Dr. Valizadeh has taught numerous sections of five different courses covering topics such as semiconductor process technology, semiconductor materials and their properties, advanced solid state devices, transistor design for modern CMOS technology, and high speed transistors. Fundamentals of Micro-Optics

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From Basic Concepts to Novel Technologies

This book shows readers how to design semiconductor devices using the most common and lowest cost logic CMOS processes. Readers will benefit from the author's extensive, industrial experience and the practical approach he describes for designing efficiently semiconductor devices that typically have to be implemented using specialized processes that are expensive, time-consuming, and low-yield. The author presents an integrated picture of semiconductor device physics and manufacturing techniques, as well as numerous practical examples of device designs that are tried and true.

Never HIGHLIGHT a Book Again! Virtually all of the testable terms, concepts, persons, places, and events from the textbook are included. Cram101 Just the FACTS101

studyguides give all of the outlines, highlights, notes, and quizzes for your textbook with optional online comprehensive practice tests. Only Cram101 is Textbook Specific. Accompanys: 9780195136050 .

Students at universities the world over will benefit from the authors' concise treatment, arising out of lectures given for a graduate and advanced undergraduate course at Penn State University (USA) and University of Technology Delft (NL). The textbook begins by addressing, in general terms, the phenomena and peculiarities that occur at the nanoscale. In the following five chapters, readers are introduced in detail to nanoscale physics, chemistry, materials science, and biology, followed by chapters on synthesis and fabrication as well as characterization at the nanoscale. In the next four chapters a variety of exemplary applications taken from a wide range of sectors are also presented and discussed. Concerns for safety, environmental impact, workforce development, economic wellbeing, and societal change issues arising from

nanotechnology are woven throughout the book and additionally form the focus of the last two chapters. Never HIGHLIGHT a Book Again! Virtually all of the testable terms, concepts, persons, places, and events from the textbook are included. Cram101 Just the FACTS101 studyguides give all of the outlines, highlights, notes, and quizzes for your textbook with optional online comprehensive practice tests. Only Cram101 is Textbook Specific. Accompanys: 9780195320176 .

An Introduction

From Additive Manufacturing to 3D/4D Printing 2

Integrated Optics

Materials Chemistry

The Science and Engineering of Microelectronic Fabrication

Alternative High-Level Waste Treatments at the Idaho

National Engineering and Environmental Laboratory

To provide an interdisciplinary readership with the necessary toolkit to work with micro- and nanofluidics, this book provides basic theory, fundamentals of microfabrication, advanced fabrication methods, device characterization methods and detailed examples of applications of nanofluidics devices

and systems. Case studies describing fabrication of complex micro- and nanoscale systems help the reader gain a practical understanding of developing and fabricating such systems. The resulting work covers the fundamentals, processes and applied challenges of functional engineered nanofluidic systems for a variety of different applications, including discussions of lab-on-chip, bio-related applications and emerging technologies for energy and environmental engineering. The fundamentals of micro- and nanofluidic systems and micro- and nanofabrication techniques provide readers from a variety of academic backgrounds with the understanding required to develop new systems and applications. Case studies introduce and illustrate state-of-the-art applications across areas, including lab-on-chip, energy and bio-based applications. Prakash and Yeom provide readers with an essential toolkit to take micro- and nanofluidic applications out of the research lab and into commercial and laboratory applications. The 3rd edition of this successful textbook continues to build on the strengths that were recognized by a 2008 Textbook Excellence Award from the Text and Academic Authors Association (TAA). Materials Chemistry addresses inorganic-, organic-, and nano-based materials from a structure vs. property treatment, providing a suitable breadth and depth coverage of the rapidly evolving materials field — in a concise format. The 3rd edition offers significant updates throughout, with expanded sections on sustainability, energy storage, metal-organic frameworks, solid electrolytes, solvothermal/microwave syntheses, integrated circuits, and nanotoxicity. Most appropriate for Junior/Senior undergraduate students, as well as first-year graduate students in chemistry, physics, or engineering fields, Materials Chemistry may also serve as a valuable reference to industrial researchers. Each chapter concludes with a section that describes important materials applications, and an updated list of thought-provoking questions.

This book is a printed edition of the Special Issue "Laser-Based Nano Fabrication and Nano

Lithography" that was published in Nanomaterials

MEMs Materials and Processes Handbook" is a comprehensive reference for researchers searching for new materials, properties of known materials, or specific processes available for MEMS fabrication. The content is separated into distinct sections on "Materials" and "Processes". The extensive Material Selection Guide" and a "Material Database" guides the reader through the selection of appropriate materials for the required task at hand. The "Processes" section of the book is organized as a catalog of various microfabrication processes, each with a brief introduction to the technology, as well as examples of common uses in MEMs.

Engineering, Medicine and Science at the Nano-Scale

Digital State

Field Effect Transistors, A Comprehensive Overview

Cram 101 Textbook Outlines to Accompany Fabrication Engineering at the Micro- and Nanoscale, Stephen A. Campbell, 3rd Edition

Electronic Concepts

Fundamentals of Microfabrication and Nanotechnology, Three-Volume Set

A clear, detailed introduction to modern analog and digital electronics, complete with simulation and design exercises.

This issue of ECS Transactions features eight invited and sixty-seven regular papers on technology, devices, systems, optoelectronics, modeling and characterization; all either directly or indirectly related to microelectronics. The topics presented herein reveal the multidisciplinary character of this field, which

definitely incites the highly cooperative trace of human nature. Accounts of the early events of the computing industry—the Turing machine, the massive Colossus, the ENIAC computer—are well-told tales, and equally well known is the later emergence of Silicon Valley and the rise of the personal computer. Yet there is an extraordinary untold middle history—with deep roots in Minnesota. From the end of World War II through the 1970s, Minnesota was home to the first computing-centered industrial district in the world. Drawing on rare archival documents, photographs, and a wealth of oral histories, Digital State unveils the remarkable story of computer development in the heartland after World War II. These decades found corporations—concentrated in large part in Minnesota—designing state-of-the-art mainframe technologies, revolutionizing new methods of magnetic data storage, and, for the first time, truly integrating software and hardware into valuable products for the American government and public. Minnesota-based companies such as Engineering Research Associates, Univac, Control Data, Cray Research, Honeywell, and IBM Rochester were major international players and together formed an unrivaled epicenter advancing digital technologies. These companies not only brought vibrant economic growth to Minnesota, they nurtured the state’s present-day medical device and software industries and possibly even tomorrow’s nanotechnology. Thomas J. Misa’s

groundbreaking history shows how Minnesota recognized and embraced the coming information age through its leading-edge companies, its workforce, and its prominent institutions. Digital State reveals the inner workings of the birth of the digital age in Minnesota and what we can learn from this era of sustained innovation.

Integrated Optics explains the subject of optoelectronic devices and their use in integrated optics and fiber optic systems. The approach taken is to emphasize the physics of how devices work and how they can be (and have been) used in various applications as the field of optoelectronics has progressed from microphotonics to nanophotonics. Illustrations and references from technical journals have been used to demonstrate the relevance of the theory to currently important topics in industry. By reading this book, scientists, engineers, students and engineering managers can obtain an overall view of the theory and the most recent technology in Integrated Optics.

Cleaning Techniques

Current Techniques, Improvements and their Limitations

Architecture and Design of Molecule Logic Gates and Atom Circuits

Powerpoint Overheads to Accompany the Science and Engineering of

Microelectronic Fabrication

Konfokale Floureszenzspektroskopie in Mikrostrukturen: Detektion, Analyse und Sortierung von Zellen und Partikeln

Outlines and Highlights for the Science and Engineering of Microelectronic Fabrication by Campbell, Isbn

Novel Optical Technologies for Nanofabrication describes recent advances made in micro/nanofabrication with super-resolution laser technologies, which are based on the latest research findings in the authors' groups. It focuses on new techniques and methods as well as applications and development trends in laser nanofabrication, including super-resolution laser direct writing, surface structures composed of laser path-guided wrinkle, three-dimensional laser nanofabrication based on two-photon absorption, and nanofabrication by laser interference and surface plasmon polaritons. This book serves as a reference for academic researchers, engineers, technical professionals and graduate students in the fields of micro/nanotechnology, thin film materials, super-resolution optics and laser techniques. Qian Liu is a Professor at Laboratory for Nanodevice, National Center for Nanoscience and Technology, China. Xuanming Duan is a Professor at the Key Laboratory of Functional Crystals and Laser Technology, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, China Changsi Peng is a Professor at the Institute of Information Optical Engineering, Soochow University, China.

Printbegrænsninger: Der kan printes 10 sider ad gangen og max. 40 sider pr. session.

From optical fundamentals to advanced applications, this comprehensive guide to micro-optics covers all the key areas for those who need an in-depth introduction to micro-optic devices,

technologies, and applications. Topics covered range from basic optics, optical materials, refraction, and diffraction, to micro-mirrors, micro-lenses, diffractive optics, optoelectronics, and fabrication. Advanced topics, such as tunable and nano-optics, are also discussed. Real-world case studies and numerous worked examples are provided throughout, making complex concepts easier to follow, whilst an extensive bibliography provides a valuable resource for further study. With exercises provided at the end of each chapter to aid and test understanding, this is an ideal textbook for graduate and advanced undergraduate students taking courses in optics, photonics, micro-optics, microsystems, and MEMs. It is also a useful self-study guide for research engineers working on optics development.

Never HIGHLIGHT a Book Again Virtually all testable terms, concepts, persons, places, and events are included. Cram101 Textbook Outlines gives all of the outlines, highlights, notes for your textbook with optional online practice tests. Only Cram101 Outlines are Textbook Specific. Cram101 is NOT the Textbook. Accompanys: 9780521673761

Introduction to Metal-Nanoparticle Plasmonics

Nuclear Science Abstracts

Solid State and Quantum Theory for Optoelectronics

Laser-Based Nano Fabrication and Nano Lithography

Proceedings of the 2nd AtMol European Workshop

The Story of Minnesota's Computing Industry

This book will address the application of gas phase thin film methods, including

techniques such as evaporation, sputtering, CVD, and ALD to the synthesis of materials on nanostructured and high aspect-ratio high surface area materials. We have chosen to introduce these topics and the different application fields from a chronological perspective: we start with the early concepts of step coverage and later conformality in semiconductor manufacturing, and how later on the range of application branched out to include others such as energy storage, catalysis, and more broadly nanomaterials synthesis. The book will describe the ballistic and continuum descriptions of gas transport on nanostructured materials and then will move on to incorporate the impact of precursor-surface interaction. We will finally conclude approaching the subjects of feature shape evolution and the connection between nano and reactor scales and will briefly present different advanced algorithms that can be used to effectively compute particle transport, in some cases borrowing from other disciplines such as radiative heat transfer. The book gathers in a single place information scattered over thirty years of scientific research, including the most recent results in the field of Atomic Layer Deposition. Besides a mathematical description of the fundamentals of thin film growth in nanostructured materials, it includes analytic expressions and plots that can be used to predict the growth using gas phase synthesis methods in a number of ideal approximations. The focus on the fundamental aspects over particular processes will broaden the appeal and the shelf lifetime of this book. The reader of this book will gain a

thorough understanding on the coating of high surface area and nanostructured materials using gas phase thin film deposition methods, including the limitations of each technique. Those coming from the theoretical side will gain the knowledge required to model the growth process, while those readers more interested in the process development will gain the theoretical understanding will be useful for process optimization.

Designed for advanced undergraduate or first-year graduate courses in semiconductor or microelectronic fabrication, Fabrication Engineering at the Micro- and Nanoscale, Fourth Edition, covers the entire basic unit processes used to fabricate integrated circuits and other devices. With many worked examples and detailed illustrations, this engaging introduction provides the tools needed to understand the frontiers of fabrication processes. NEW TO THIS EDITION Coverage of many new topics including: - the flash and spike annealing processes - extreme ultraviolet (EUV) lithography - GaN epitaxial growth and doping - double exposure routes to sub-35-nm lithography - architectures for nanoscale CMOS as practiced at the 45-nm node - trigate or FINFET CMOS planned for 22 nm and below - bulk silicon and thin film solar cell manufacturing - GaN LED fabrication - microfluidics Updated sections on nonoptical lithography Expanded content on state-of-the-art CMOS A Companion Website with PowerPoint slides of figures from the text (www.oup.com/us/campbell) An Instructor's Solutions Manual, available to

registered adopters of the text (978-0-19-986121-7)

The Science and Engineering of Microelectronic Fabrication provides an introduction to microelectronic processing. Geared towards a wide audience, it may be used as a textbook for both first year graduate and upper level undergraduate courses and as a handy reference for professionals. The text covers all the basic unit processes used to fabricate integrated circuits including photolithography, plasma and reactive ion etching, ion implantation, diffusion, oxidation, evaporation, vapor phase epitaxial growth, sputtering and chemical vapor deposition. Advanced processing topics such as rapid thermal processing, nonoptical lithography, molecular beam epitaxy, and metal organic chemical vapor deposition are also presented. The physics and chemistry of each process is introduced along with descriptions of the equipment used for the manufacturing of integrated circuits. The text also discusses the integration of these processes into common technologies such as CMOS, double poly bipolar, and GaAs MESFETs.

Complexity/performance tradeoffs are evaluated along with a description of the current state-of-the-art devices. Each chapter includes sample problems with solutions. The book also makes use of the process simulation package SUPREM to demonstrate impurity profiles of practical interest.

Processes and Design for Manufacturing, Third Edition, examines manufacturing processes from the viewpoint of the product designer, investigating the selection of

manufacturing methods in the early phases of design and how this affects the constructional features of a product. The stages from design process to product development are examined, integrating an evaluation of cost factors. The text emphasizes both a general design orientation and a systems approach and covers topics such as additive manufacturing, concurrent engineering, polymeric and composite materials, cost estimation, design for assembly, and environmental factors. Appendices with materials engineering data are also included.

Microfabrication for Microfluidics

Novel Optical Technologies for Nanofabrication

Microelectronics Technology and Devices - SBMicro 2009

Circuit Design, Layout, and Simulation

Wind Energy Program

Non-logic Devices in Logic Processes