

Kazuo Kondo · Masahiro Kado
Kenji Takahashi Editors

Three- Dimensional Integration of Semiconductors

Processing, Materials, and Applications



Springer

Three Dimensional Integration Semiconductors Processing Applications

Katsuyuki Sakuma



Three Dimensional Integration Semiconductors Processing Applications:

Three-Dimensional Integration of Semiconductors Kazuo Kondo,Morihiro Kada,Kenji Takahashi,2015-12-09 This book starts with background concerning three dimensional integration including their low energy consumption and high speed image processing and then proceeds to how to construct them and which materials to use in particular situations The book covers numerous applications including next generation smart phones driving assistance systems capsule endoscopes homing missiles and many others The book concludes with recent progress and developments in three dimensional packaging as well as future prospects

Three-Dimensional Integration of Semiconductors Kazuo Kondo,Morihiro Kada,Kenji Takahashi,2015 This book starts with background concerning three dimensional integration including their low energy consumption and high speed image processing and then proceeds to how to construct them and which materials to use in particular situations The book covers numerous applications including next generation smart phones driving assistance systems capsule endoscopes homing missiles and many others The book concludes with recent progress and developments in three dimensional packaging as well as future prospects

Handbook of 3D Integration, Volume 1 Philip Garrou,Christopher Bower,Peter Ramm,2011-09-22 The first encompassing treatise of this new but very important field puts the known physical limitations for classic 2D electronics into perspective with the requirements for further electronics developments and market necessities This two volume handbook presents 3D solutions to the feature density problem addressing all important issues such as wafer processing die bonding packaging technology and thermal aspects It begins with an introductory part which defines necessary goals existing issues and relates 3D integration to the semiconductor roadmap of the industry Before going on to cover processing technology and 3D structure fabrication strategies in detail This is followed by fields of application and a look at the future of 3D integration The contributions come from key players in the field from both academia and industry including such companies as Lincoln Labs Fraunhofer RPI ASET IMEC CEA LETI IBM and Renesas

Semiconductor Wafer Bonding VII : Science, Technology, and Applications ,2003

Semiconductor Wafer Bonding H. Baumgart,2002 **Handbook of Wafer Bonding** Peter Ramm,James Jian-Qiang Lu,Maaik M. V. Taklo,2012-02-13 The focus behind this book on wafer bonding is the fast paced changes in the research and development in three dimensional 3D integration temporary bonding and micro electro mechanical systems MEMS with new functional layers Written by authors and edited by a team from microsystems companies and industry near research organizations this handbook and reference presents dependable first hand information on bonding technologies Part I sorts the wafer bonding technologies into four categories Adhesive and Anodic Bonding Direct Wafer Bonding Metal Bonding and Hybrid Metal Dielectric Bonding Part II summarizes the key wafer bonding applications developed recently that is 3D integration MEMS and temporary bonding to give readers a taste of the significant applications of wafer bonding technologies This book is aimed at materials scientists semiconductor physicists the semiconductor industry IT engineers

electrical engineers and libraries **Oriented Crystallization on Amorphous Substrates** E.I. Givargizov, 2013-11-21

Present day science and technology have become increasingly based on studies and applications of thin films. This is especially true of solid state physics, semiconductor electronics, integrated optics, computer science and the like. In these fields it is necessary to use films with an ordered structure, especially single crystalline films, because physical phenomena and effects in such films are most reproducible. Also active parts of semiconductor and other devices and circuits are created as a rule in single crystal bodies. To date single crystalline films have been mainly epitaxial or heteroepitaxial, i.e. they have been grown on a single crystalline substrate and principal trends, e.g. in the evolution of integrated circuits (ICs) have been based on continuing reduction in feature size and increase in the number of components per chip. However, as the size decreases into the submicrometer range, technological and physical limitations in integrated electronics become more and more severe. It is generally believed that a feature size of about 0.1 μm will have a crucial character. In other words, the present two dimensional ICs are anticipated to reach their limit of minimization in the near future and it is realized that further increase of packing density and/or functions might depend on three dimensional integration. To solve the problem, techniques for preparation of single crystalline films on arbitrary including amorphous substrates are essential. **Wafer Level 3-D ICs**

Process Technology Chuan Seng Tan, Ronald J. Gutmann, L. Rafael Reif, 2009-06-29 Three dimensional 3D integration is clearly the simplest answer to most of the semiconductor industry's vexing problems: heterogeneous integration and reductions of power, form factor, delay, and even cost. Conceptually, the power, latency, and form factor of a system with a fixed number of transistors all scale roughly linearly with the diameter of the smallest sphere enclosing frequently interacting devices. This clearly provides the fundamental motivation behind 3D technologies which vertically stack several strata of device and interconnect layers with high vertical interconnectivity. In addition, the ability to vertically stack strata with divergent and even incompatible process flows provides for low cost and low parasitic integration of diverse technologies such as sensors, energy scavengers, nonvolatile memory, dense memory, fast memory, processors, and RF layers. These capabilities coupled with today's trends of increasing levels of integrated functionality, lower power, smaller form factor, increasingly divergent process flows, and functional diversification would seem to make 3D technologies a natural choice for most of the semiconductor industry. Since the concept of vertical integration of different strata has been around for over 20 years, why aren't vertically stacked strata endemic to the semiconductor industry? The simple answer to this question is that in the past the 3D advantages while interesting, were not necessary due to the tremendous opportunities offered by geometric scaling. In addition, even when the global interconnect problem of high performance single core processors seemed insurmountable, without innovations such as 3D alternative architectural solutions such as multicores could effectively delay but not eliminate the need for 3D.

Nanoelectronics and Information Technology Rainer Waser, 2012-05-29 This outstanding textbook provides an introduction to electronic materials and device concepts for the major areas of current and future information technology. On

about 1 000 pages it collects the fundamental concepts and key technologies related to advanced electronic materials and devices The obvious strength of the book is its encyclopedic character providing adequate background material instead of just reviewing current trends It focuses on the underlying principles which are illustrated by contemporary examples The third edition now holds 47 chapters grouped into eight sections The first two sections are devoted to principles materials processing and characterization methods Following sections hold contributions to relevant materials and various devices computational concepts storage systems data transmission imaging systems and displays Each subject area is opened by a tutorial introduction written by the editor and giving a rich list of references The following chapters provide a concise yet in depth description in a given topic Primarily aimed at graduate students of physics electrical engineering and information technology as well as material science this book is equally of interest to professionals looking for a broader overview Experts might appreciate the book for having quick access to principles as well as a source for getting insight into related 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

Handbook of 3D Integration, Volume 3 Philip Garrou,Mitsumasa Koyanagi,Peter Ramm,2014-04-22 Edited by key figures in 3D integration and written by top authors from high tech companies and renowned research institutions this book covers the intricate details of 3D process technology As such the main focus is on silicon via formation bonding and debonding thinning via reveal and backside processing both from a technological and a materials science perspective The last part of the book is concerned with assessing and enhancing the

reliability of the 3D integrated devices which is a prerequisite for the large scale implementation of this emerging technology Invaluable reading for materials scientists semiconductor physicists and those working in the semiconductor industry as well as IT and electrical engineers Comprehensive Semiconductor Science and Technology ,2024-11-28 Semiconductors are at the heart of modern living Almost everything we do be it work travel communication or entertainment all depend on some feature of semiconductor technology Comprehensive Semiconductor Science and Technology Second Edition Three Volume Set captures the breadth of this important field and presents it in a single source to the large audience who study make and use semiconductor devices Written and edited by a truly international team of experts and newly updated to capture key advancements in the field this work delivers an objective yet cohesive review of the semiconductor world The work is divided into three sections fully updated and expanded from the first edition The first section is concerned with the fundamental physics of semiconductors showing how the electronic features and the lattice dynamics change drastically when systems vary from bulk to a low dimensional structure and further to a nanometer size Throughout this section there is an emphasis on the full understanding of the underlying physics especially quantum phenomena The second section deals largely with the transformation of the conceptual framework of solid state physics into devices and systems which require the growth of high purity or doped bulk and epitaxial materials with low defect density and well controlled electrical and optical properties The third section is devoted to design fabrication and assessment of discrete and integrated semiconductor devices It will cover the entire spectrum of devices we see all around us for telecommunications computing automation displays illumination and consumer electronics Provides a comprehensive global picture of the semiconductor world Written and Edited by an international team of experts Compiles the most important semiconductor knowledge into one comprehensive resource Moves from fundamentals and theory to more advanced knowledge such as applications allowing readers to gain a deeper understanding of the field **Scientific and Technical Aerospace Reports** ,1993 Three Dimensional System Integration Antonis Papanikolaou,Dimitrios Soudris,Riko Radojcic,2010-12-07 Three dimensional 3D integrated circuit IC stacking is the next big step in electronic system integration It enables packing more functionality as well as integration of heterogeneous materials devices and signals in the same space volume This results in consumer electronics e g mobile handheld devices which can run more powerful applications such as full length movies and 3D games with longer battery life This technology is so promising that it is expected to be a mainstream technology a few years from now less than 10 15 years from its original conception To achieve this type of end product changes in the entire manufacturing and design process of electronic systems are taking place This book provides readers with an accessible tutorial on a broad range of topics essential to the non expert in 3D System Integration It is an invaluable resource for anybody in need of an overview of the 3D manufacturing and design chain *Semiconductor Wafer Bonding 9: Science, Technology, and Applications* Helmut Baumgart,2006 This issue of ECS Transactions covers state of the art R D results of the last 1 5 years in the field of

semiconductor wafer bonding technology Wafer Bonding Technology can be used to create novel composite materials systems and devices what would otherwise be unattainable Wafer bonding today is rapidly expanding applications in such diverse fields as photonics sensors MEMS X ray optics non electronic microstructures high performance CMOS platforms for high end servers Si Ge strained SOI Germanium on Insulator GeOI and Nanotechnologies Chemical Abstracts ,2002

3D IC Stacking Technology Banqiu Wu,Ajay Kumar,Sesh Ramaswami,2011-10-14 The latest advances in three dimensional integrated circuit stacking technology With a focus on industrial applications 3D IC Stacking Technology offers comprehensive coverage of design test and fabrication processing methods for three dimensional device integration Each chapter in this authoritative guide is written by industry experts and details a separate fabrication step Future industry applications and cutting edge design potential are also discussed This is an essential resource for semiconductor engineers and portable device designers 3D IC Stacking Technology covers High density through silicon stacking TSS technology Practical design ecosystem for heterogeneous 3D IC products Design automation and TCAD tool solutions for through silicon via TSV based 3D IC stack Process integration for TSV manufacturing High aspect ratio silicon etch for TSV Dielectric deposition for TSV Barrier and seed deposition Copper electrodeposition for TSV Chemical mechanical polishing for TSV applications Temporary and permanent bonding Assembly and test aspects of TSV technology Annual IEEE Semiconductor Thermal Measurement and Management Symposium ,1998 3D Integration in VLSI Circuits Katsuyuki Sakuma,2018-04-17 Currently the term 3D integration includes a wide variety of different integration methods such as 2 5 dimensional 2 5D interposer based integration 3D integrated circuits 3D ICs 3D systems in package SiP 3D heterogeneous integration and monolithic 3D ICs The goal of this book is to provide readers with an understanding of the latest challenges and issues in 3D integration TSVs are not the only technology element needed for 3D integration There are numerous other key enabling technologies required for 3D integration and the speed of the development in this emerging field is very rapid To provide readers with state of the art information on 3D integration research and technology developments each chapter has been contributed by some of the world s leading scientists and experts from academia research institutes and industry from around the globe Covers chip wafer level 3D integration technology memory stacking reconfigurable 3D and monolithic 3D IC Discusses the use of silicon interposer and organic interposer Presents architecture design and technology implementations for 3D FPGA integration Describes oxide bonding Cu SiO₂ hybrid bonding adhesive bonding and solder bonding Addresses the issue of thermal dissipation in 3D integration *IBM Journal of Research and Development* ,1985

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