

Process Engineering Analysis In Semiconductor Device Fabrication

Semiconductor device fabrication

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Semiconductor device fabrication is the process used to manufacture semiconductor devices, typically integrated circuits (ICs) such as microprocessors, microcontrollers, and memories (such as RAM and flash memory). It is a multiple-step photolithographic and physico-chemical process (with steps such as thermal oxidation, thin-film deposition, ion-implantation, etching) during which electronic circuits are gradually created on a wafer, typically made of pure single-crystal semiconducting material. Silicon is almost always used, but various compound semiconductors are used for specialized applications. Steps such as etching and photolithography can be used to manufacture other devices such as LCD and OLED displays.

The fabrication process is performed in highly specialized semiconductor fabrication...

Semiconductor device

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A semiconductor device is an electronic component that relies on the electronic properties of a semiconductor material (primarily silicon, germanium, and gallium arsenide, as well as organic semiconductors) for its function. Its conductivity lies between conductors and insulators. Semiconductor devices have replaced vacuum tubes in most applications. They conduct electric current in the solid state, rather than as free electrons across a vacuum (typically liberated by thermionic emission) or as free electrons and ions through an ionized gas.

Semiconductor devices are manufactured both as single discrete devices and as integrated circuits, which consist of two or more devices—which can number from the hundreds to the billions—manufactured and interconnected on a single semiconductor wafer (also...

Semiconductor industry

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The semiconductor industry is the aggregate of companies engaged in the design and fabrication of semiconductors and semiconductor devices, such as transistors and integrated circuits. Its roots can be traced to the invention of the transistor by Shockley, Brattain, and Bardeen at Bell Labs in 1948. Bell Labs licensed the technology for \$25,000, and soon many companies, including Motorola (1952), Schockley Semiconductor (1955), Sylvania, Centralab, Fairchild Semiconductor and Texas Instruments were making transistors. In 1958 Jack Kilby of Texas Instruments and Robert Noyce of Fairchild independently invented the Integrated Circuit, a method of producing multiple transistors on a single "chip" of Semiconductor material. This kicked off a number of rapid advances in fabrication technology...

List of semiconductor fabrication plants

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This is a list of semiconductor fabrication plants, factories where integrated circuits (ICs), also known as microchips, are manufactured. They are either operated by Integrated Device Manufacturers (IDMs) that design and manufacture ICs in-house and may also manufacture designs from design-only (fabless firms), or by pure play foundries that manufacture designs from fabless companies and do not design their own ICs. Some pure play foundries like TSMC offer IC design services, and others, like Samsung, design and manufacture ICs for customers, while also designing, manufacturing and selling their own ICs.

Semiconductor process simulation

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Semiconductor process simulation is the modeling of the fabrication of semiconductor devices such as transistors. It is a branch of electronic design automation, and part of a sub-field known as technology CAD (TCAD).

The ultimate goal of process simulation is an accurate prediction of the active dopant distribution, the stress distribution and the device geometry. Process simulation is typically used as an input for device simulation, the modeling of device electrical characteristics. Collectively process and device simulation form the core tools for the design phase known as technology computer aided design (TCAD). Considering the integrated circuit design process as a series of steps with decreasing levels of abstraction, logic synthesis would be at the highest level and TCAD, being closest...

Doping (semiconductor)

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In semiconductor production, doping is the intentional introduction of impurities into an intrinsic (undoped) semiconductor for the purpose of modulating its electrical, optical and structural properties. The doped material is referred to as an extrinsic semiconductor.

Small numbers of dopant atoms can change the ability of a semiconductor to conduct electricity. When on the order of one dopant atom is added per 100 million intrinsic atoms, the doping is said to be low or light. When many more dopant atoms are added, on the order of one per ten thousand atoms, the doping is referred to as high or heavy. This is often shown as n+ for n-type doping or p+ for p-type doping. (See the article on semiconductors for a more detailed description of the doping mechanism.) A semiconductor doped to such...

IEEE Transactions on Semiconductor Manufacturing

semiconductor device fabrication, including simulation and modeling from the factory to the detailed process level, defect control, yield analysis and optimization

The IEEE Transactions on Semiconductor Manufacturing is a quarterly peer-reviewed scientific journal published by the IEEE. It covers research on semiconductor device fabrication, including simulation and modeling from the factory to the detailed process level, defect control, yield analysis and optimization, production planning and scheduling, environmental issues in semiconductor manufacturing, and manufacturability improvement. The editor-in-chief is Reha Uzsoy (North Carolina State University). According to the Journal Citation Reports, the journal has a 2020 impact factor of 2.874.

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Electronic engineering

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Electronic engineering is a sub-discipline of electrical engineering that emerged in the early 20th century and is distinguished by the additional use of active components such as semiconductor devices to amplify and control electric current flow. Previously electrical engineering only used passive devices such as mechanical switches, resistors, inductors, and capacitors.

It covers fields such as analog electronics, digital electronics, consumer electronics, embedded systems and power electronics. It is also involved in many related fields, for example solid-state physics, radio engineering, telecommunications, control systems, signal processing, systems engineering, computer engineering, instrumentation engineering, electric power control, photonics and robotics.

The Institute of Electrical...

Microfabrication

used for integrated circuit fabrication, also known as "semiconductor manufacturing" or "semiconductor device fabrication". In the last two decades, microelectromechanical

Microfabrication is the process of fabricating miniature structures of micrometre scales and smaller. Historically, the earliest microfabrication processes were used for integrated circuit fabrication, also known as "semiconductor manufacturing" or "semiconductor device fabrication". In the last two decades, microelectromechanical systems (MEMS), microsystems (European usage), micromachines (Japanese terminology) and their subfields have re-used, adapted or extended microfabrication methods. These subfields include microfluidics/lab-on-a-chip, optical MEMS (also called MOEMS), RF MEMS, PowerMEMS, BioMEMS and their extension into nanoscale (for example NEMS, for nano electro mechanical systems). The production of flat-panel displays and solar cells also uses similar techniques.

Miniaturization...

Multigate device

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A multigate device, multi-gate MOSFET or multi-gate field-effect transistor (MuGFET) refers to a metal-oxide-semiconductor field-effect transistor (MOSFET) that has more than one gate on a single transistor. The multiple gates may be controlled by a single gate electrode, wherein the multiple gate surfaces act electrically as a single gate, or by independent gate electrodes. A multigate device employing independent gate electrodes is sometimes called a multiple-independent-gate field-effect transistor (MIGFET). The most widely used multi-gate devices are the FinFET (fin field-effect transistor) and the GAAFET (gate-all-around field-effect transistor), which are non-planar transistors, or 3D transistors.

Multi-gate transistors are one of the several strategies being developed by MOS semiconductor...

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