

Semiconductor Glossary

*A Resource for
Semiconductor
Community*

Second Edition

Jerzy Ruzyllo

Semiconductor Glossary

*A Resource for
Semiconductor Community*

Second Edition

Semiconductor Glossary

*A Resource for
Semiconductor Community*

Second Edition

Jerzy Ruzyllo
Penn State University, USA

 **World Scientific**

NEW JERSEY • LONDON • SINGAPORE • BEIJING • SHANGHAI • HONG KONG • TAIPEI • CHENNAI • TOKYO

chemical etching process of either wet (liquid-phase) or dry (gas-phase) etching through the chemical reaction between chemically reactive etching species and etched material; chemical etching is isotropic and selective.

etch, isotropic etch, selective etch, physical etching, wet etching, dry etching

Chemical-Mechanical Planarization, CMP increased force mechanical interactions between polishing pads and the patterned wafer surface enhanced by the chemically reactive slurry; a combination of chemical etching and abrasive polishing carried out for the purpose of surface planarization through the removal of excess material; commonly used in the definition of metal interconnect pattern; key process in back-end of line IC manufacturing.

surface planarization, BEOL, damascene

Chemical Mechanical Polishing, CMP a reduced-force mechanical interactions between polishing pads and the wafer surface enhanced by the chemically reactive slurry; a combination of chemical etching and abrasive polishing carried out for the purpose of reducing surface roughness; can be performed on the front surface of the wafer or front and back surfaces simultaneously.

wafer fabrication, wafer thinning, slurry, double-sided polishing, surface planarization

chemical oxide an oxide growing on the surface of semiconductors during wet cleaning and rinsing operations; highly hydrated with composition departing from stoichiometric native oxide; in the case of Si chemical oxide can be defined as SiO_x with $0 < x < 2$.

APM, native oxide

Chemical Vapor Deposition, CVD the most common thin-film deposition method in advanced semiconductor manufacturing; deposited species are formed as a result of the chemical reaction between gaseous reactants at elevated temperature in the vicinity of the substrate or on its surface; solid product of the reaction is deposited on the surface of the substrate; used to deposit films of semiconductors (crystalline and non-crystalline), insulators as well as metals; key variations of CVD processes include Atmospheric

epitaxial layer

epitaxial deposition *see epitaxy.*

epitaxial extension formation of an epitaxial layer on the surface of bulk wafer.

engineered wafer; bulk wafer; SOI wafer

epitaxial growth *see epitaxy.*

Epitaxial Lateral Overgrowth, ELO local epitaxial growth which initially occurs in the direction normal to the surface of the substrate, but then proceeds preferentially in the direction parallel to the surface of the substrate; vertical growth starts from the single-crystal seed area, but lateral growth continues over non-crystalline portion of the substrate; can be used to form SOI substrates.

epitaxy, SOI

epitaxial layer a layer grown as a result of epitaxial deposition, or epitaxy; its crystallographic structure reproduces structure of the substrate, but doping level and conductivity type of epitaxial layer is controlled independently of the substrate; can be made chemically purer than the substrate, but substrate surface defects are reproduced in the epitaxial layer; silicon substrates with epitaxial layers are commonly used in CMOS and bipolar device technology.

epitaxy

epitaxy an “ordered deposition”; a process by which thin layer of single-crystal material is deposited on single-crystal substrate; epitaxial growth occurs in such way that the crystallographic structure of the substrate is reproduced in the growing material; also crystalline defects of the substrate surface are reproduced in the growing material; a key process in advanced semiconductor device engineering.

single-crystal

epitaxy by CVD epitaxial growth implemented by means of chemical vapor deposition, i.e. by chemical reaction in the gas-phase product of

J

JBS see *Junction Barrier Controlled Schottky*.

JFET see *Junction Field Effect Transistor*.

JLT see *junctionless transistor*.

Josephson effect a tunneling current flow between two superconductors separated (coupled) by the ultra-thin insulator in the absence of electric field.

Josephson junction a device designed to implement Josephson effect; made by sandwiching non-superconducting material between two layers of superconducting materials; listed here because of its potential for being used in the very high-speed digital (logic) electronics replacing semiconductor based devices.

Josephson effect

Joule heating the generation of heat in the metal by passing an electric current; also known as resistance heating and ohmic heating; commonly used in the tools employed in semiconductor processing.

furnace, inductive heating

junction in semiconductor materials and devices a region in which two materials featuring different work functions are brought to contact; e.g. *p-n* junction and metal-semiconductor junction (contact).

work function, junction p-n, metal-semiconductor contact

Junction Barrier Controlled Schottky, JBS a Schottky diode based power rectifier with arrays of *p-n* junctions built into the drift region.

Schottky diode

junction breakdown the sudden increase of current flowing across the reverse biased junction; under certain conditions results in the irreversible,

than 100% particle removal efficiency, and hence, is not broadly used in commercial applications.

particle

laser diode see *semiconductor laser*.

laser heating allows localized (also in terms of depth) rapid heating of semiconductor wafers and other solids; very useful when local heating is needed, e.g. in local CVD processes such as those used to repair masks; type of laser (wavelength of radiation) is selected depending on the type of material to be heated.

RTP, mask repair, CVD

laser interferometry the endpoint detection method in dry etching tools; completion of the etching process is determined based on the detection of change in the optical characteristics of the laser beam reflected from the etched surface.

endpoint detection

laser, semiconductor see *semiconductor laser*.

latch-up a highly undesired (“parasitic”) effect occurring in CMOS devices; condition under which significant current flows through Si substrate between NMOS and PMOS parts of CMOS cell and degrades its performance; it occurs when under certain bias conditions two parasitic bipolar transistors resulting from CMOS configuration “latch” and provide high conductivity path between NMOS and PMOS parts of the cell; various CMOS designs were conceived to prevent latch-up; implementation of CMOS technology on SOI substrates is an ultimate solution to the CMOS latch-up challenge.

CMOS, SOI

lateral diffusion diffusion of dopant atoms in the direction parallel to the surface of semiconductor; undesired in semiconductor device manufacturing as it causes lateral distortion of the device geometry.

diffusion, vertical diffusion

lateral etching an isotropic etching proceeding also in the direction parallel to the surface; undesired, and hence avoided, in the case when very tight geometrical features need to be defined by etching; desired and used in select MEMS etching applications.

isotropic etch, anisotropic etch, MEMS release

lateral transistor a bipolar transistor (BJT), typically $p-n-p$, in which current flows across the base in the direction parallel to the wafer surface; in contrast to conventional vertical bipolar transistor in which current across the base flows in the direction normal to the surface; lateral transistor features inferior characteristics as compared to vertical transistor due to the inferior control over the base width in the lateral configuration.

base width, bipolar transistor

LATID Large-Angle-Tilt Implanted Drain; part of the drain engineering strategy in ultra-small geometry CMOS.

drain engineering, ion implantation

lattice a periodic three dimensional arrangement of atoms in a crystal; specific to a given material; formed by infinite repetition of unit cell in all three spatial directions.

crystal lattice, cubic system, unit cell

lattice cell same as *unit cell*; repeated in all three spatial directions to form a crystal lattice.

lattice, unit cell

lattice constant, a distance between atoms in cubic-cell crystals; in non-cubic crystals more than one lattice constants are identified; a measure of structural compatibility between various crystals.

lattice, lattice mismatch, lattice matched structures

lattice matched structure a structure consisting of ultra-thin layers of different single-crystal semiconductors (typically III-V) which are compositionally adjusted such that they feature matching lattice constants; allows changes of energy gap from layer to layer maintaining the same

O

OBIC Optical Beam Induced Current, a semiconductor material characterization technique based on the analysis of the laser beam induced current.

OEM Original Equipment Manufacturer.

OFET Organic Field Effect Transistor; a thin-film transistor (TFT) formed using organic semiconductors.

Field-Effect Transistor, organic semiconductor, thin-film transistor

ohmic contact a metal-semiconductor contact featuring very low resistance which is independent of applied voltage (may be represented by constant resistance); to form an “ohmic” contact the metal and semiconductor must be selected such that there is no potential barrier formed at the interface or the potential barrier is so thin that charge carriers can readily tunnel through it.

metal-semiconductor contact, tunneling

ohmic heating see *Joule heating*.

OLED see *organic LED*.

OLED display an emissive display fabricated using organic light-emitting diodes (OLEDs); can be flexible if formed on the flexible substrate.

emissive display, flexible display

omega gate 3D MOS gate which shape in cross-section resembles Greek letter “omega” (Ω); variation of FinFET technology.

FinFET, gate allaround, pi-gate

OMVPE Organo-Metallic Vapor Phase Epitaxy.

epitaxy