Society of Vacuum Coaters

Glossary of Terms and Acronyms for Vacuum Coating Technology

Abridged with permission from *The Foundations of Vacuum Coating Technology* by Donald M. Mattox
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A

Abnormal glow discharge (plasma) The DC glow discharge where the cathode spot covers the whole cathode and an increase in the voltage increases the cathode current density. This is the type of glow discharge used in most plasma processing. See Normal glow discharge.

Abrasion test (characterization) Testing film adhesion and abrasion resistance by rubbing, impacting or sliding in contact with another surface or surfaces. Examples**: Tumble test**, **Tabor test**, **Eraser test.**

Abrasive cleaning The removal of surface material (gross cleaning), including contamination, by an abrasive action.

Abrupt-type interface (film formation) The interface that is formed between two materials (A and B) when there is no diffusion or chemical compound formation in the interfacial region. The transition of A to B in the length of a lattice parameter (≈3Å). See Interface.

Activated Reactive Evaporation (ARE) (PVD technology) Evaporation through a plasma of reactive gas in order to deposit a film of a compound material. The plasma activation increases the reaction probability and decreases the pressure of reactive gas needed to form the compound material.

Activation, plasma The process of making a species more chemically reactive by excitation, ionization, fragmentation or forming new materials in a plasma.

Adatom (film formation) The atom that has been deposited on the surface and that is still mobile (not condensed) on the surface.

Adsorption pump, vacuum (vacuum technology) A capture-type vacuum pump that pumps by cryocondensation or cryotrapping on a surface whose temperature is less than -150°C. See Vacuum pump.

Afterglow (plasma) The region outside the plasma-generation region where long-lived plasma species persist. Also called **Downstream location** or **Remote location**.

Agglomeration (film growth) Collecting into isolated regions (clumps).

Altered region (ion bombardment) The region near the surface which has been altered by the physical penetration of the bombarding species or by "knock-on" lattice atoms. In the extreme case this can lead to the amorphorization of the region. See Near-surface region.

Alternating Current (AC) A potential that reverses polarity (and thus direction of current flow) each cycle.

Ambient conditions (vacuum technology, contamination control) Conditions such as pressure, air composition, temperature, etc., that are present in the processing area.

Angle-of-incidence (film formation) The angle of impingement of the depositing adatom flux as measured from the normal to the surface.

Ångstrom (Å) A unit of length equal to 10^{-10} meters or 0.1 nanometer.

Anisotropy, film properties (film formation) Properties that differ in different direction in the plane of the film. Often due to anisotropy in the flux of depositing material or anisotropy in the bombardment during deposition.

Anode The positive electrode in a gas discharge or electroplating bath.

Anodic arc, plasma (plasma technology) An arc vaporization source where the vaporized material originates from a molten anode electrode. Also called a **Distributed Arc**. See Arc source.

Applied bias (PVD technology) An electrical potential applied from an external source. See Bias.

Arc A high-current, low-voltage electrical discharge between two electrodes or between areas at different potentials. See Arc source.

Arc, gaseous An arc formed in a chamber containing enough gaseous species to aid in establishing and maintaining an electrical arc. See Arc, vacuum.

Arc, vacuum An arc formed in a vacuum such that all of the ionized species originate from the arc electrodes. See Arc, gaseous.

Arc suppression Techniques for quenching an arc before it becomes too destructive. These include: shutting-off the power or introducing a voltage pulse with an opposite polarity.

Arc vapor deposition (Physical vapor deposition, vacuum deposition processes) Film deposition process where the source of vapor is from arc vaporization.

Arc vaporization Vaporization of a solid (cathodic) or liquid (anodic) electrode material using a vacuum or gaseous arc. Characterized by high ionization of the vaporized material. Also called **Arc evaporation**.

Argon (sputtering) An inert gas used for sputtering because it is relatively inexpensive compared to other inert gases and has a reasonably high mass (40 amu).

Asymmetrical AC Where the amplitude, duration and/or waveform of the voltage in one polarity of an alternating current (AC) voltage cycle is different from that in the other polarity. See Alternating current (AC), Bipolar DC.

Atomic mass unit (amu) The atomic mass unit is defined as $1/12$ of the mass of the ^{12}C isotope. Also called the **Unified atomic mass unit (u)**. One amu = 1.66×10^{-24} g.

Atomic peening (film formation) The continuous or periodic bombardment of a depositing film with high energy atoms or ions to densify the depositing film material. Atomic peening tends to introduce compressive stress into the surface.

Atomic percent (alloy) The percentage by atomic ratio of one material in an alloy composition. Abbreviated at%. See **Weight percent**. Example: An alloy of W:30at%Ti has the same composition as W:10wt%Ti.

Augmented plasma (plasma technology) A plasma that has had electrons injected from an outside source to enhance ionization.

Auxiliary plasmas (plasma technology) A plasma established in a processing system to assist in some aspect of the processing separate from the main processing event. Example: Plasma cleaning in a vacuum deposition system, plasma activation of the reactive gas near the substrate in a reactive magnetron sputter deposition system.

Availability, reactive gas (film formation) The availability of the reactive gas over the surface of the film being deposited. Since the surface of the film is continually being buried, reactive gas availability is an important parameter in reactive deposition.

B

Back-diffusion (vacuum technology) Flow of vapor in a direction opposite to that of the flow of gas being pumped. Occurs in the molecular flow range. Also called **Backstreaming**.

Backing plate (sputtering target) The plate that the target material is bonded to that allows mounting to the cooling portion of the sputtering target assembly.

Backside film (semiconductor processing) Film or coating deposited on the backside of a silicon wafer during processing of the frontside (the side on which the device structure is being built).

Baffle (PVD technology) A system of surfaces to prevent a cold surface from seeing the thermal radiation from the processing chamber.

Baffle source (evaporation) (PVD technology) An evaporation source in which the vapor must collide with several hot surfaces before it can leave the source. Used to evaporate materials such as selenium and silicon monoxide which vaporize as clusters of atoms or molecules.

Baking, vacuum (cleaning) Heating of a material at an elevated temperature for a period of time sufficient to reduce volatile constituents such as water, solvents and plasticizers to an acceptable level. Care must be taken not to heat the material to a temperature at which it will decompose. The necessary time and temperature is generally determined using weight-loss or mass spectroscopic analysis.

Banding (PVD technology) A striped pattern on large-area substrates or webs due to variation in film thickness, morphology or composition across the width of the substrate.

Barrel plating (electroplating, PVD technology) Plating objects that are loose inside a rotating grid structure (cage or barrel) so that they are tumbled and completely covered. See Fixture.

Barrier film (diffusion, permeation) A film used to reduce the diffusion into a surface or through a film. Example: TiN underneath aluminum metallization on silicon to prevent diffusion of Al into the silicon on heating; aluminum film on a polymer web to reduce water permeation through packaging material.

Basecoat (PVD technology) A film, often a polymer, that is applied to a surface to produce a smooth surface (**Flow coat**), to seal-in material that will outgas during vacuum processing, or to provide a "**Glue-layer**" for adhesion.

Batch (PVD technology) A group of substrates that are processed in the same fixture in one "run".

Bias, applied (PVD technology) An electrical potential applied from an external source.

Bias, electrical (PVD technology) The electrical potential between one surface or region and another surface or region.

Bias, magnetic (PVD) Magnetic field in the vicinity of the substrate during deposition to affect the structure and orientation of deposited magnetic films.

Bias, self (plasma technology) An electrical potential on a surface generated by the accumulation of excess electrons (**Negative self-bias**) or positive ions (**Positive self-bias**). See Sheath potential.

Bias sputtering Sputter deposition with a bias on the substrate to accelerate ions to the surface during deposition. See Ion plating.

Bipolar DC A term used by some to describe a potential that reverses polarity during some part of each cycle (thus it is really an AC potential). See AC potential, Asymmetric AC.

Boat source (evaporation) An evaporation source where the charge is contained in a cavity in a surface. Generally the boat is of tungsten, tantalum or molybdenum and is heated resistively. The cavity may be coated with a ceramic so that the molten charge does not come into contact with the metal. See Evaporation source.

Bombardment-enhanced chemical reactions (film formation) Chemical reactions on a surface that are enhanced by bombardment by high energy atomic-sized particles. The effect is due to heating, dissociation of adsorbed species, production of electrons, etc. Important effect in reactive deposition, PECVD, plasma etching and reactive ion etching.

Box coater (deposition chamber) A direct-load deposition chamber in the form of a flat-sided box, often with gussets, with one or more sides being a door. See Deposition system.

Bulkhead mounting (vacuum technology) When a chamber is mounted through a wall such that the chamber opening is on one side and the pumping plumbing is on the other side of the wall. This design ensures that persons working on the pumping system do not contaminate the processing environment of the opening side. See Pass box.

C

Cathode The negative electrode in a gas discharge or electroplating bath.

Cathode spot (plasma technology) The area on the cathode, under normal glow discharge conditions, in which the current is concentrated. As the current increases the spot becomes bigger in order to maintain a constant current density in the cathode spot. In the **Abnormal glow discharge** the cathode spot covers the whole cathode area.

Cathodic arc (PVD technology) A vaporization source where the vaporized material originates from a high current density arc on the cathode surface which is usually solid. See Anodic arc.

Channeling (ion bombardment) The preferential movement of an energetic ion or atom along the open region between crystallographic planes in a solid crystal.

Charge exchange (plasma) When a positive ion gains an electron from a neutral atom. If the ion has a high energy the process produces a high-energy neutral and a low-energy ion.

Chemical pumping The removal of gas by having it react with a material to form a compound having a low vapor pressure. Also called **Gettering**. See Getter pumping, Getters, Ion pumping.

Chemical sputtering (cleaning, etching) Bombardment of a surface with a chemical species (e.g. Cl, F) which forms a volatile compound with the surface material. See Reactive plasma cleaning, Reactive plasma etching, Physical sputtering.

Chemical Vapor Deposition (CVD) The deposition of atoms or molecules by the reduction or decomposition of a chemical vapor species (precursor gas) which contains the material to be deposited. Example: Silicon (Si) from silane (SiH_4). See Vapor Phase Epitaxy, Decomposition reaction (CVD), Reduction reaction (CVD), Disproportionation reaction (CVD).

Chemical vapor precursor (CVD, reactive deposition) A gaseous chemical species that contains the species to be deposited. Example: Silane (SiH_4) for silicon, methane (CH_4) for carbon.

Cleaning (cleaning) Reduction of the amount of contamination on a surface to an acceptable level.

Cleaning, external (cleaning) Cleaning done external to the deposition chamber.

Cleaning, gross (cleaning) Cleaning process designed to remove all types of surface contaminants, generally by removing some of the underlying surface material.

Cleaning, *in situ* (cleaning) Cleaning done in the deposition chamber.

Cleaning, plasma (cleaning) Cleaning done using an inert or reactive gas plasma either as an external cleaning process in a **Plasma cleaner** or as an *in situ* cleaning process in the deposition system. See Glow bar.

Cleaning, solvent (cleaning) Cleaning using a solvent that takes the contamination into solution. See Solubility test, Specific cleaning.

Cleaning, specific (cleaning) Cleaning process designed to remove a specific contaminant. Example: Removal of a hydrocarbon contaminant by oxidation.

Cleaning, sputter (cleaning) A gross, *in situ* cleaning process where the substrate surface is sputtered prior to the film deposition.

Coating Term applied to overlayed material on a surface greater than several microns in thickness. Sometimes used synonymously with film. See Overlay, Thin film, Surface modification.

Coating, first surface Coating on the side of the substrate on which the incident radiation impinges. Also called **Front surface coating**. Example: First surface mirror.

Coating, second surface Coating on the side of a transparent substrate opposite the side on which the incident radiation impinges. Also called a **Back surface coating**. Example: Back surface mirror.

Collimated sputter deposition (PVD technology) Reduction of the non-normal flux from a sputtering target by using a honeycomb-shaped mechanical filter between the target and the substrate. Used to increase the throwing power in covering high-aspect-ratio surface features.

Columnar morphology (film formation) The morphology that develops with thickness due to the development of surface roughness due to preferential film deposition on high points on the surface. The columnar morphology resembles stacked posts and the columns are not single grains. See Macrocolumnar morphology.

Comets The visual trail in the deposition system left by molten globules emitted from a thermal vaporization or arc vaporization source. See Spits, Macros.

Condensation energy (film formation) The energy released upon condensing an atom or molecule from the vapor. See Heat of vaporization.

Conditioning, target (sputtering) Removal of the surface contamination such as oxides and degassing of the target material, before sputter deposition begins.

Conformal target (sputtering) A sputtering target made conformal to the shape of the substrate in order to keep a constant spacing.

Contamination (PVD technology) The materials in the vacuum system in a concentration high enough to interfere with the deposition process or to affect the film properties in an unacceptable manner.

Contamination, external environment-related (contamination control) Contamination brought-in from the external processing environment. Example: Particulate contamination from dust.

Contamination, process-related (contamination control) Contamination from the deposition process. Example: Outgassing of evaporation source, volatilization of hydrocarbons from contaminated evaporation material.

Contamination, system-related (contamination control) Contamination coming from the deposition system. Example: Backstreaming from pump oils, particulates from pinhole flaking in the system.

Coordination number (crystallography) The number of nearest-neighbor atoms to a point in a lattice or on a surface.

Corona discharge Electrical breakdown of the gas near a surface due to a high electric field that exceeds the dielectric strength of the gas. Usually seen at high-field points such as tips but can be found over planar electrically insulating surfaces which have been charged by an rf field. Example: St. Elmo's fire seen in nature under high electric field conditions.

Corona treatment (surface modification) Treatment of polymer surfaces in a corona discharge in order to give the surface a higher surface energy and make it more wettable.

Cosine Law, Knudsen's The intensity of flux from a point source impinging on a flat surface normal to the direction to the point of emission is proportional to the cosine of the angle subtended by the source at the plane surface and inversely proportional to the square of the distance ($\cos\Theta/r^2$).

Critical cleaning (cleaning) Removal of contaminants from a surface to a predetermined level. Also called **Precision cleaning**.

Crosstalk (sputtering) When material from one sputtering target is deposited on another target.

Cycle time, processing The time for one complete processing sequence including loading and unloading.

Cylindrical (hollow) magnetron (sputtering) A hollow cylindrical tube often with ends flared toward the interior where a magnetic field confines the secondary electrons emitted from the inside surface to paths parallel to the axis of the tube (magnetron configuration). The flares prevent the loss of the electrons from the ends of the tube. See Magnetron.

D

Damage threshold (bombardment) The energy at which radiation or bombarding particles will introduce damage to the atomic structure of a material, thus changing its properties. Example: Bombarding growing TiO_2 films with argon ions having an energy greater than 300 eV will increase the optical absorptivity of the deposited film material.

Dark space, cathode (plasma) The darker region of a plasma near the cathode surface where most of the potential drop in a DC diode discharge occurs. Region where electrons are being accelerated away from the cathode. Also called the **Cathode sheath**.

Dark space shield (plasma) A grounded surface that is placed at less than a dark space width from the cathode in order to prevent establishing a discharge in the region between the two surfaces. Also called the **Ground shield**. See Paschen curve.

DC glow discharge (plasma) The plasma discharge established between two electrodes in a low-pressure gas and in which most of the potential drop is near the cathode surface and a plasma region (positive glow) where there is little potential drop that can extend for an appreciable distance.

De-excitation (plasma) The return of an electron in an excited state to a lower energy level accompanied by the release of optical radiation. Also called **Relaxation**.

De-wetting growth (film formation) When the nuclei tend to grow normal to the surface rather than laterally over the surface. See Wetting growth.

Decorative coating A coating whose function is to be decorative so that the properties of the coating of interest are primarily reflectivity, color, color distribution and texture. Example: Aurora Borealis coating.

Decorative/functional coating A coating which has both the requirement of a decorative coating but also improves some functional property such as abrasion, wear, corrosion, etc. Example: Decorative coating on a plumbing fixture or door hardware. See Functional coating, Decorative coating.

Deposition rate Mass or thickness of material deposited per unit time. Measured in micrograms per cm^2 per sec, nanometers per second or Ångstroms per second.

Deposition system (PVD technology) A vacuum system used for physical vapor deposition processing.

Deposition system, direct-load A system where the processing chamber is opened to the ambient each time the fixture is placed into or removed from the chamber. Also called a **Batch system**.

Deposition system, dual-chamber A chamber which has two separate sections separated by a low conductance path. The sections may be independently pumped or there may be two different gas pressures in the sections. This allows high gas load operations, such as unrolling a web, to be performed in a section separate from the film deposition section.

Deposition system, in-line A series of sequential vacuum modules in a line beginning and ending with load-lock chambers that allows the substrate to enter one end and exit the other end without reversing direction.

Deposition system, load-lock A system which has a chamber intermediate between the ambient and the deposition chamber that allows the substrate to be outgassed, heated, etc., before being placed in the deposition chamber. The substrates are passed from the load-lock chamber into the deposition chamber through an **Isolation valve using Transfer-tooling**. In the **Rotary load-lock** the substrate passes through several chambers before returning to the insertion/removal chamber.

Deposition system, web coater Specialized direct-load deposition system used to coat web material which is often on very large, heavy rolls. Often a dual-chamber system. Also called a **Roll coater**.

Dewetting growth (film formation) When nuclei on a surface grow by atoms avoiding the surface and the nuclei grow normal to the surface. Example: Gold on carbon. See Wetting growth.

Diamond-like carbon (DLC) An amorphous carbon material with mostly sp^3 bonding that exhibits many of the desirable properties of diamond but does not have the crystal structure of diamond.

Dichroic coating An optical coating that reflects certain wavelengths and allows others to pass through. Example: Heat mirror, sunglass coatings. See Ophthalmic coatings, Band-pass coatings.

Diffusion-type interface (film formation) When the interfacial material (interphase material) that has been formed during the deposition of A onto B along with subsequent diffusion, consists of an alloy of A and B with a gradation in composition. See Interface, Kirkendall porosity, Interphase material.

Direct current (DC) A voltage waveform where the polartity is the same or zero at all tmes. See Pulsed DC.

Direct-load processing system A single-chamber vacuum system where the chamber is opened to the ambient each time the chamber is loaded or unloaded. Also called a Batch processing system.

Disappearing anode effect (sputtering) In reactive deposition of electrically insulating films, the surfaces in the deposition chamber become covered with an insulating film and the electron flow to the grounded surface (anode) must change position as the surfaces become coated.

Documentation (manufacturing) The documentation that is maintained in order to know what was done during the processing and the status of the processing equipment. This enables reproducible processing to be performed.

Documentation, Log A dated document detailing who, when and what was done. See Log, calibration, Log, maintenance, Log, run time.

Documentation, Manufacturing Processing Instruction (MPI) Detailed instructions for the performance of each operation and the use of specific equipment, based on the specification, that apply to each stage of the process flow. MPIs are developed based on the specifications.

Documentation, Process Flow Diagram (PFD) A diagram showing each successive stage in the processing sequence including storage, handling and inspection. A PFD is useful in determining that there are MPIs that cover all stages of the processing.

Documentation, Specifications (Specs) The formal document which contains the "recipe" for a process and which defines the materials to be used, how the process is to be performed, the parameter windows and other important information related to safety, etc. Information on all critical aspects on the process flow sheet should be covered by Specifications.

Documentation, Travelers Archival document that accompanies each batch of substrates detailing when the batch was processed and the specifications and MPIs used for processing. The traveler also includes the **Process sheet** which details the process parameters of the deposition run. Also called a **Run-card** in semiconductor processing.

Dose (ion bombardment) The total number of bombarding particles per unit area.

Dry process A process that uses no fluids. Often desirable in context of waste disposal.

E

E-beam evaporation (PVD technology) Evaporation in a good vacuum using a focused high-energy low-current electron beam as the means of directly heating the material to be evaporated.

Electrode An electrically conductive surface that is active in carrying an electric current. See Cathode, Anode.

Electron Elementary particle having a negative charge and a mass of approximately 1/1840 that of a hydrogen atom.

Electron beam (e-beam) (evaporation) Heating and evaporation of a material by an electron beam. The electron beam generally has a low-current of high-energy electrons and is directed to the surface of the material to be evaporated and may be **Rastered** over the surface during heating. Electron beam of low-energy and high-current can be used to evaporate material but the term e-beam is generally applied to a beam using high-energy electrons.

Electron impact excitation (plasma chemistry) Excitation of an atom or molecule by electron impact. See Excitation.

Electron impact fragmentation (plasma chemistry) Fragmentation of a molecule by electron impact.

Electron impact ionization (plasma chemistry) Ionization of an atom or molecule by the impact of an electron causing the loss of an electron. See Ionization.

Electron volt (eV) The amount of kinetic energy imparted to a singly charged particle when accelerated through a potential of one volt. Equal to 1.602×10^{-19} Joules. A particle with 1 eV of energy has a temperature equivalent to about 11600 K.

Epitaxial growth (film formation) Growth of one crystal on another such that the growth of the deposited crystal is determined by the crystalline orientation of the underlying surface.

Epitaxy Oriented overgrowth of an atomistically deposited film. See Epitaxial growth, Homoepitaxy, Heteroepitaxy.

Epitaxy, Heteroepitaxy Oriented overgrowth on a substrate of a different material or the same material with a different crystalline structure. Example: Silicon on sapphire.

Epitaxy, Homoepitaxy Oriented overgrowth on a substrate of the same material. Example: Silicon on doped silicon.

Equilibrium vapor pressure The pressure above a surface when there are as many atoms leaving the surface as are returning to the surface (isothermal closed container). See Saturation vapor pressure.

Evaporant (PVD technology) The material to be evaporated.

Evaporation Vaporization from a liquid surface. See Sublimation.

Evaporation-to-completion (PVD technology) Complete vaporization of the charge of evaporant. A common method of obtaining reproducible film thickness from run-to-run if the geometry of the system and other conditions remain constant.

Evaporation rate, free surface The amount of material leaving the surface per unit of time when there are no collisions above the surface to cause backscattering of the material to the surface. See Langmuir Equation.

Evaporation source (PVD technology) The source used to evaporate a material.

Evaporation source, baffle An evaporation source in which the vapor must collide with several hot surfaces before it can leave the source. Used to evaporate materials such as selenium and silicon monoxide which vaporize as clusters of atoms or molecules.

Evaporation source, boat Evaporation from a resistively heated surface in the shape of a boat or canoe.

Evaporation source, coil A thermal evaporation source in the form of a coil, usually of stranded wire, that is wetted by the molten material and allows deposition in all directions.

Evaporation source, confined vapor A thermal evaporation source where the vapor is confined in a cavity and the substrate, such as a wire, is passed through the cavity.

Evaporation source, crucible A container for holding a large amount of molten material. The crucible may be of a number of shapes such as a symmetrical pot or a high-capacity elongated trough (**Hog-trough crucible**).

Evaporation source, e-beam, focused Evaporation using a focused high-energy low-current electron beam as the means of heating the surface of the material directly.

Evaporation source, e-beam, unfocused Evaporation using an unfocused low-energy high-current electron beam as the means of heating the material directly or by heating the crucible containing the material.

Evaporation source, feeding An evaporation source in which the evaporant material is replenished either during the deposition process of after the deposition process.

External processing environment (PVD technology) The processing environment external to the deposition system in which processes such as cleaning, racking and un-racking take place.

F

Feeding source (evaporation) An evaporation source in which the evaporant material is replenished either during the deposition process or after the deposition process. See Evaporation source, Flash evaporation.

Feeding source, pellet A mechanism to feed individual pellets into a molten pool to replenish the charge or onto a hot surface for flash evaporation.

Feeding source, powder A mechanism to feed powder into a molten pool to replenish the charge or onto a hot surface for flash evaporation.

Feeding source, rod-feed A focused e-beam source where the surface of the end of a rod is being heated and the molten material is contained in a cavity of the rod material. As the material is vaporized the rod is moved so as to keep the molten material in the same position with respect to the e-beam.

Feeding source, tape feed An evaporation source where the melt material is continually or periodically renewed by a tape being fed into the molten material. Generally a tape is easier to feed than a wire.

Feeding source, wire feed An evaporation source where the melt material is continually or periodically renewed by a wire being fed into the molten material.

Field-free region (plasma) A region in which there is no electric field. Usually generated by having the region surrounded by an electrical conductor (soild or as a grid).

Film (substrate) A free-standing flexible structure of limited thickness. Also called a **Web**.

Film ions (PVD technology) Ions of the condensable film material being deposited. Often accelerated to a high kinetic energy in an electric field.

Filtered arc source An arc vaporization source designed to filter out the macros, generally by deflecting the plasma beam. See Arc source, Plasma duct.

Fixture (film deposition) The removable and generally reusable structure that holds the substrates during the deposition process. The fixture is generally moved, often on several axes, by tooling during the deposition process. In some cases the same fixture is used to hold the substrates during the cleaning process. See Rack, Tooling.

Fixture, cage (film deposition, electroplating) A container with wire mesh sides that contains loose parts and is rotated during the deposition process to allow complete coverage of the parts. Also called a **Barrel fixture**.

Fixture, callote A hemispherical cap-shaped fixture on which the substrates are mounted. Often used in thermal evaporation to keep the substrate surfaces an equal distance from the point-evaporation source and keep the angle-of-incidence of the deposition normal to the substrate surfaces.

Fixture, carousel A fixture on which parts are mounted and then moved in a circular motion (like a merry-go-round). Example: In front of a sputtering target or between two sputtering targets.

Fixture, cassette (semiconductor processing) A storage fixture that hold wafers so that the paddle can perform a pick-n-place motion. See Paddle.

Fixture, christmas tree A fixture that has a number of branches on which parts are hung. Also called a **Tree fixture**.

Fixture, drum A cylindrical fixture where the substrates are mounted on the walls of a cylinder or mounted on structural members positioned in a cylindrical arrangement.

Fixture, drum, rotisserie A planetary arrangement using a cylindrical drum fixture where the parts are mounted in a cylindrical arrangement around the axis of rotation of the drum and rotate about a second axis.

Fixture, ladder (thermal evaporation) A fixture for holding a number of evaporator filaments in a vertical array so as to approximate a line source.

Fixture, pallet A planar surface on which the substrates lie or are mounted. The pallet may be held horizontal or verticle. Often the initial angle-of-incidence of the depositing material is high, which can lead to film-density problems.

Fixture, planetary A fixture that has a motion around one fixed axis and several moving axes in a plane.

Fixture, vibratory pan A fixture for coating small parts by placing them in a pan that is vibrated causing the parts to move about and allowing 100% coverage of the part. Also called a **Shaker table**.

Flakes (contamination control) Particles of film material that become dislodged in the vacuum system and generate particulate contamination in the system.

Flash evaporation (film deposition) The deposition of a material by rapid heating so that there is no time for diffusion or selective evaporation. Flash evaporation is used to deposit alloy materials where widely different vapor pressures prevent uniform vaporization of the elemental components of the alloy.

Flash evaporation, exploding wire The heating and vaporization of a wire by the sudden discharge of an electrical current through the wire.

Flash evaporation, laser ablation Vaporization of a surface by the adsorption of energy from a laser pulse.

Flash evaporation, pellet feed Where individual pellets are fed onto a hot surface where they are completely vaporized before the next pellet is dropped.

Flash evaporation, wire tapping Where the tip of a wire is periodically tapped against a hot surface so the tip of the wire is periodically vaporized.

Floating potential The electrical potential assumed by a material that is electrically isolated from ground.

Flow chart, process (manufacturing) A schematic diagram of the processing, including inspection, characterization, handling and storage, that a substrate encounters in going from the as-received material to the final product. The flow chart is useful in determining that complete documetaion has been developed for all phases of the processing.

Flux (particle bombardment) The number of particles per unit area per unit time. Example: Ions per cm^2 per second. Also called the **Dose rate.**

Flux distribution (film deposition) The angular distribution of the particles incident on the substrate surface.

Flux distribution (vaporization) The angular distribution of the particles leaving a vaporization source. See Cosine distribution.

Flux ratio (ion plating) The ratio of the number of energetic bombarding particles to the deposition rate of the depositing condensable film atoms.

Fractionation, by evaporation (PVD Technology) When preferential vaporization of one constituent of a vaporizing melt occurs due to its higher vapor pressure leaving the melt with an increasingly higher proportion of the less-volatile material. See Fractional distillation, Raoult's Law.

Frank-van der Merwe growth mode (film formation) Layer-by-layer growth where there is strong interaction between the depositing atoms and the substrate. Complete coverage of the substrate is attained in a few monolayer film thickness. See Volmer-Weber (island) growth, Stranski-Krastanov (pseudomorphic) growth.

Functional coating A coating that improves the functional properties of a surface such as wear-resistance, corrosion-resistance, abrasion-resistance, bondability, etc.

G

Gas A state of matter in which the molecular constituents move freely and expand to fill the container which holds it. Generally the term includes vapors. See Vapor.

Gas discharge See Glow discharge.

Gas evaporation Vaporization into a gaseous environment which has a gas density sufficient to allow collisions that lead to gas phase nucleation and the generation of ultrafine particles in the gas. See Ultrafine particles.

Gas incorporation (film formation) Incorporation of soluble or insoluble gases during film growth either by physical trapping or by low-energy implantation by bombarding species. Example: Incorporation of helium in gold films. See Charging, hydrogen.

Gas scatter plating (film deposition) Increasing the throwing power of the depositing atoms by scattering the atoms in a gaseous atmosphere. Does not work very well without a plasma due to gas phase nucleation and the deposition of ultrafine particles. When a plasma is present the ultrafine particles become negatively charged and do not deposit on the substrate particularly if the substrate is at a negative potential as in ion plating.

Gas scattering Scattering of a high velocity atom by collision with gas molecules. See Thermalization, Gas scatter plating.

Gas-phase nucleation (particle formation) The nucleation of atoms in a gaseous environment where multi-body collisions allow the removal of the energy released on condensation. See Gas evaporation.

Gaseous arc An arc formed in a chamber containing enough gaseous species to aid in establishing and maintaining the arc. See Vacuum arc.

Glow bar (PVD technology) A high voltage electrode that allows a glow discharge to be established in a vacuum chamber for cleaning and surface treatment purposes. The glow bar should be as large as possible in order to generate as uniform a plasma as possible throughout the chamber.

Glow (plasma) The visual emission from a glow discharge, particularly the plasma region.

Glow discharge (plasma) The plasma generation region and other contiguous plasma-containing regions such as the plasma region, the afterglow region and wall sheath. Also called a **Gas Discharge**.

Glow discharge cleaning Subjecting a surface to a plasma of an inert or reactive gas to enhance desorption of gases and, in the case of reactive gas plasma, by forming volatile species that leave the surface. Cleaning occurs by the action of ions accelerated across the wall sheath, radiation from the plasma, and energy released on the surface by the recombination of ions and electrons. In the cases of reactive gas plasmas, chemical reactions occurs on the surface. See Ion scrubbing, Reactive plasma cleaning.

Glue-layer (adhesion) An intermediate layer between the film and the substrate used to increase adhesion. Also called a **Bond coat**. Example: The titanium layer in a titanium-gold metallization on an oxide. The titanium chemically reacts with the oxide and alloys with the gold.

Grading The gradual changing of a property or composition from one value to another. Example: Graded density coating, grading composition from Ti to TiN by controlling nitrogen availability during reactive deposition, grading TCE by grading glass composition in a glass-to-metal seal.

Graded interface (film formation) When the interfacial region between a film and a substrate has composition or properties that vary throughout the thickness. See Interphase material.

Ground (electrical) The electrical plane, usually earth, which has a common zero potential and to which most electrical circuits are referenced by being attached (i.e., grounded).

Ground shield (plasma technology) A grounded surface placed at less than a dark-space distance from a DC cathode surface in order to prevent a glow discharge from forming on the surface. See Paschen curve.

H

Hard coating A coating that extends the life of a tool that is subject to wear such as a drill bit, extrusion die, injection mold, etc. The mechanism may not be entirely related to hardness of the coating. For example the coating can reduce the friction and thus prolong tool life or it may provide a diffusion barrier that prevents adhesion and galling.

Hearth (e-beam evaporation) The water-cooled structure that has a depression called a pocket in which the material to be evaporated is contained. See Pocket; Skull; Liner, Pocket.

Heat of condensation Heat released by the physisorption or chemisorption of species on a surface. See Heat of vaporization.

Heat of reaction Heat taken up (endothermic) or released (exothermic) during a chemical reaction.

Heat of vaporization Heat taken up during the vaporization of a molecule from a surface and released on condensation. Example: The heat of vaporization of gold from a tungsten surface equals about 3 eV per atom. See Heat of condensation.

Heteroepitaxy Oriented overgrowth on a substrate of a different material or the same material with a different crystalline structure. Example: Silicon on sapphire. See Homoepitaxy.

Heterogeneous nucleation (film formation) Nucleation of one material on a different material. Example: Silicon on sapphire. See Homogeneous nucleation.

High energy neutrals (sputtering) High energy neutral species formed by neutralization and reflection of the high energy bombarding ions during sputtering.

High energy neutrals (plasma chemistry) High energy neutral species formed by charge exchange processes.

High vacuum (PVD technology) A gas pressure in which there is no significant amount of gaseous contamination that will affect the deposition process or the properties of the deposited film.

Hollow cathode (plasma) A cathode with a deep cylindrical cavity or tube such that the electrons are trapped in the cavity and are effective in ionizing gases in the cavity. The cathode can be heated to the point that there is thermoelectron emission (**Hot hollow cathode**). The hollow cathode can be used as an electron source.

Homoepitaxy Oriented overgrowth of a film on a substrate of the same material. Example: Silicon on doped silicon. Also called **Isoepitaxy**. See Heteroepitaxy.

Homogeneous nucleation Nucleation of atoms on a surface of the same material. Example: Silicon-on-silicon. See Heterogeneous nucleation.

Hybrid deposition system (PVD technology) System using two or more deposition techniques in sequence usually in separate chambers. See Deposition system.

Hybrid process (PVD technology) Deposition process that uses more than one deposition technique at the same time. Example: Reactive deposition of a carbonitride by sputtering a metal in a gas containing nitrogen, argon and acetylene where the acetylene is decomposed in the plasma (VLP-PECVD) to provide the carbon thus making a hybrid PVD/PECVD process.

I

***In situ* cleaning** (PVD technology) Cleaning in the deposition system. Examples: Ion scrubbing, Reactive plasma cleaning, Sputter cleaning.

In-chamber contamination (cleaning) Contamination that occurs in the deposition system during pumpdown and vacuum processing. Example: Backstreaming of pump oils into the deposition chamber.

In-house coater (surface engineering) A manufacturing facility that only coats items for one group that controls their actions. See Contract coater and Jobshop.

In-line processing system In-line PVD processing systems use several processing chambers connected together to sequentially process the substrates. The in-line systems are characterized by having the substrates moving from chamber-to-chamber in one direction so that a substrate can be processed in each module all the time.

In-line processing system, valve-isolation In the Valve Isolation In-line system there is a valve between processing chambers.

In-line processing system, pump-isolation In the Pump Isolation In-line system there is a intermediate chamber ("tunnel") between the processing chambers. This intermediate chamber has a low conductance for gas flow between chambers and the region is actively pumped to prevent gases from one chamber getting into the other chamber.

In-line processing system, vacuum transfer In the Vacuum Transfer in-line system the fixture is moved into and out of a common transfer chamber that is under "rough" vacuum.

In-line processing system, controlled-atmosphere transfer In the Inert Transfer In-line system the transfer chamber is at atmospheric pressure, so hermetically sealed gloves can be used. The gas in the transfer chamber can be a dry air if the product is moisture sensitive or an inert gas, such as argon or nitrogen, if chemical reaction is a problem.

Inert gas A gas that doesn't chemically react with surfaces under processing conditions. They include: "noble" gases that have filled electron shells (e.g., He, Ne, Ar, Kr, Xe) and thus are chemically inert, and other gases such as nitrogen under specific conditions.

Interface (film formation) The region of contact between two materials. See Interphase material.

Interface, abrupt The interface that is formed between two materials (A and B) when there is no diffusion or chemical compound formation in the interfacial region. The transition of A to B in the length of a lattice parameter (≈3Å).

Interface, combination An interface composed of several types of materials such as an alloy with a second phase dispersed in it.

Interface, compound When the interfacial material (interphase material) that has been formed during the deposition of A onto B along with subsequent diffusion and reaction, consists of a compound of A and B such as an intermetallic compound.

Interface, diffusion When the interfacial material (interphase material) that has been formed during the deposition of A onto B along with subsequent diffusion, consists of an alloy of A and B with a gradation in composition. See Kirkendall porosity, Interphase material.

Interface, mechanical interlockng A "tongue-and-groove" interlocking where the materials "key" into each other at the interface and a fracture that follows the interface must take a circuitous route with greatly changing stress tensors as the fracture propagates.

Interface, pseudodiffusion An interfacial region where the material is graded, similar to the diffusion interface. Produced by mechanical means such as beginning the second deposition before stopping the first deposition, or by implantation of high energy "film ions."

Interfacial flaws (film formation, adhesion) Flaws, such as microcracks or voids, that reduce the fracture strength of the interphase material.

Interphase material (adhesion, film formation) The material at the interface that is formed by diffusion, reaction or co-deposition at the interface between the film and the substrate. The properties of this material are an important consideration in adhesion. Also called **Interfacial material**.

Ion An atom or molecule that has an excess (**Negative ion**) or deficiency (**Positive ion**) of electrons.

Ion Assisted Deposition (IAD) (film deposition) Concurrent or periodic bombardment with energetic reactive ions during film deposition. See ion plating. When using an ion beam the process is sometimes called Ion Beam Assisted Deposition.

Ion Beam Assisted Deposition (IBAD) (film deposition) A special case of ion plating where the deposition is done in a high vacuum and the concurrent or periodic bombardment is provided by gaseous ions accelerated from an ion gun or plasma source. Also called **Vacuum-based ion plating** or **Ion Beam Enhanced Deposition**. Also called **Ion Assisted Deposition (IAD).**

Ion Beam Deposition (film deposition) Deposition of a film using ions of the film material, usually obtained by the decomposition of a vapor precursor in a plasma source. Example: Deposition of i-C from methane decompopsed in a plasma source.

Ion Beam Enhanced Deposition (IBED) A special case of ion plating where the deposition is done in a high vacuum and the concurrent or periodic bombardment is provided by ions accelerated from an ion gun or plasma source. Also called **Ion Beam Assisted Deposition (IBAD)** (preferred).

Ion beam sputtering Physical sputtering using an energetic ion beam from an ion gun in a good vacuum.

Ion Cluster Beam (ICB) deposition (PVD technology) A deposition process in which clusters of atoms (1000s of atoms) are electrically charged and accelerated to the substrate to deposit with greater than thermal energy.

Ion plating (PVD technology) There is no universally accepted definition of the term "ion plating." Ion plating can be defined as a film deposition process in which the growing film is subjected to concurrent or periodic high energy ion bombardment in order to modify film growth and the properties of the deposited film. The term does not specify the source of depositing atoms (sputtering, thermal evaporation, arc vaporization, chemical vapor precursors, etc.) nor the source of bombarding species (plasma, ion gun, plasma source, etc.) or whether the bombarding species is reactive, nonreactive or a "film ion." Other definitions restrict the configuration to using an evaporation source or a DC diode plasma. Also called **Ion Assisted Deposition (IAD)** and **Ion Vapor Deposition (IVD).**

Ion plating, arc Ion plating where the source of vaporized material is from arc vaporization.

Ion plating, chemical Ion plating where the source of depositing material is from a chemical vapor precursor species such as CH_4.

Ion plating, reactive Ion plating in a reactive gaseous environment where a film of a compound material is deposited.

Ion plating, sputter (SIP) Ion plating where the source of vaporized material is from sputtering of a solid surface.

Ion plating, vacuum See Ion Beam Assisted Deposition (IBAD).

Ion scrubbing (cleaning) The desorption of adsorbed species from a surface in contact with a plasma under the action of ions accelerated across the plasma sheath.

Ion Vapor Deposition (IVD) Ion plating generally using aluminum as the film material. Terminology used mostly in the aerospace industry. **See Ion plating.**

Ionization The formation of ions, generally by electron-atom/molecule impact. Other processes, such as Penning ionization, can also cause ionization.

Island-channel-continuous (film formation) The development of a continuous film under Volmer-Weber nucleation conditions where isolated nuclei grow in size, contact each other and then fill-in to form a continuous film.

K

Keyholing (metallization, semiconductor) When the opening of a high aspect ratio hole or trench closes during film deposition before the bottom of the hole or trench is filled. See Mouse hole.

Kirkendall porosity (film formation, adhesion) Porosity which develops in the interfacial region between two materials when the first material diffuses faster into the second than the second diffuses into the first thus producing a loss of mass and formation of voids in the interfacial region. Also called **Kirkendall voids**.

Knudsen cell (PVD technology) A thermal vaporization source which emits vapor through an orifice from a cavity where the vapor pressure is carefully controlled by controlling the temperature. Used in Molecular Beam Epitaxy (MBE) processing. Also called an **Effusion cell**.

L

Laser ablation (vaporization) Vaporization by the adsorption of energy from a laser pulse. Also called **Laser vaporization**.

Laser Ablation Deposition (LAD) (film deposition) PVD using laser vaporization as the vapor source. Also called **Pulsed Laser Deposition (PLD).**

Laser enhanced CVD Increasing the reaction rate using a laser to provide thermal energy by the adsorption of radiation by the substrate or by **Photodecomposition** of the chemical vapor precursor.

Life-test (characterization) Evaluation of a function or property under specific conditions that simulate service conditions, in order to determine how long it will function correctly. See Shelf life.

Life-test, accelerated (characterization) Evaluation of a property or function under conditions that will accelerate failure and allow the determination of the activation energy for failure. By using the Arrhenius relationship, the failure time under less severe conditions can be calculated provided the activation energy for failure and failure mode remain constant. See Arrhenius equation.

Liner, pocket (e-beam evaporation) A crucible-like container that is sometimes used in the pocket of the e-beam evaporation hearth to lower the conductive heat-loss from the melt and to allow easy removal of the charge from the hearth.

Liquid-like behavior, nuclei (film formation) The ability of nuclei to move and rotate on a substrate surface.

Load-lock system (PVD processing) A two- (or more) system where the deposition chamber is not opened to the ambient during each processing cycle; rather the fixture is loaded through a separate loading chamber that is isolated from the deposition chamber by a valve. See Direct-Load system.

Loading factor (PVD processing) A processing variable which is the dependence of the processing parameters on the number of substrates, or the total surface area of the substrates being processed.

Long-focus electron beam (evaporation) A high power electron gun that allows heating and evaporation by focusing an electron beam on the surface from a source that is a long distance away and without bending the electron beam. Example: Pierce gun. See Deflected electron beam.

Lot (PVD technology) All of the materials (substrates, source material, etc.) of identical purity, structure, composition, etc., obtained in a single shipment and traceable to a specific manufacturer.

Low Pressure CVD (LPCVD) (Vacuum deposition processes) Chemical vapor deposition that is performed in a vacuum. See Chemical Vapor Deposition, Plasma Enhanced CVD.

Low Pressure PECVD (LPPECVD) (vacuum deposition processes) Plasma enhanced CVD performed at a low enough pressure (10-20 mTorr) that high energy ion bombardment effects occur. See Plasma Enhanced CVD.

M

Macrocolumnar morphology (film formation) The large-sized columnar morphology that develops due to the initial surface roughness of the substrate. See Columnar morphology.

Macros (arc vaporization) Molten globules of electrode material ejected under arcing conditions from a solid cathode and deposited onto the substrate giving nodules in the film. See Filtered arc source, Plasma duct.

Magnetron A crossed-field electromagnetic system where the path of electrons accelerated in an electric field is controlled by a magnetic field at an angle to the electric field. In a magnetron tube the electron motion is used to generate microwave radiation (**Klystron tube**). See Magnetron.

Magnetron (sputtering) Sputtering using a crossed-field electromagnetic configuration to keep the ejected secondary electrons near the cathode (target) surface and in a closed path on the surface. This allows a dense plasma to be established near the surface so that the ions that are accelerated from the plasma do not sustain energy loss by collision before they bombard the sputtering target. The closed path can be easily generated on a planar surface or on any surface of revolution. Also called a **Surface magnetron**.

Magnetron, conical A magnetron configuration where the target surface is the interior surface of a truncated conical section. The anode is often positioned in the region of the small diameter portion of a doubly truncated cone. Also called an **S-gun**.

Magnetron, hemispherical A magnetron configuration where the target surface is the interior surface of a hemispherical section. The anode is often positioned around the lip of the hemisphere.

Magnetron, hollow cathode A magnetron configuration where the target surface is the interior surface of a cup. Permanent and moving magnets are used to shape the magnetic field in the cup.

Magnetron, hollow cylinder A magnetron configuration where the target surface is the interior surface of a hollow cylinder. The cylinder often has a flange at each end to prevent loss of electrons.

Magnetron, planar A magnetron configuration where the target surface is a planar surface and the magnetic field is in a configuration such that it is round or oval. The sputter-erosion track resembles a "**Racetrack**."

Magnetron, post A magnetron configuration which is a post, perhaps with flares on the ends (spool), with a magnetic field either axial to the post or in a series of looped magnetic fields around the post. The electrons are confined along the surface of the post and between the flared ends. Also called a **Spool magnetron**.

Magnetron, rotatable cylinder A planar-like magnetron configuration where the target surface is the exterior surface of a hollow water-cooled tube which is rotated through the magnetic field.

Magnetron, unbalanced (sputtering) A magnetron configuration in which the magnetic fields are arranged so as to allow some of the secondary electrons to escape from the vicinity of the cathode in order to establish a plasma between the target and the substrate.

Magnetrons, dual AC Two planar magnetrons that are side-by-side and are alternately the cathode and anode of an AC (< 50kHz) voltage. This arrangement eliminates the **Disappearing anode** effect in reactive sputter deposition.

Magnetrons, dual unbalanced Two unbalanced planar magnetrons positioned such that they face each other with the surface to be coated positioned between the two magnetrons. Generally the north escaping field of one magnetron faces the south escaping field of the other magnetron.

Mandrel (electroplating, CVD, PVD technology) A form (substrate) on which a coating is deposited that is subsequently removed, leaving a free-standing structure. See Vapor forming.

Manufacturability The issues involved in commercially producing an item including patent position, availability of raw materials, availability of components from outside suppliers, availability of suitable manufacturing space, scale-up, costs, etc. See Scale-up.

Manufacturing, early Manufacturing in the early stages where there are numerous experiments to fine-tune the processing parameters and equipment development to improve product yield and throughput. Many changes to the process documentation.

Manufacturing, mature Manufacturing after the equipment and processes have been optimized and there are few changes to the documentation.

Manufacturing Process Instruction (MPI) Detailed instructions for the performance of each operation and the use of specific equipment, based on the specifications, that apply to each stage of the process flow. MPIs are developed based on the Specifications. See Process flow diagram, Specifications

Mask (PVD technology) A physical cover that prevents film deposition on an area of the substrate surface. The mask may be in contact with the surface or in the line-of-sight from the source to the substrate. See Mask, moving.

Mask, moving (film formation) A method of forming a film structure having a specific thickness distribution by using a moving mask to determine the area and time on which the film material is being deposited on specific areas of the substrate.

May Term used in a Specification or MPI that grants permission. Example: The gloves may be reused. See Should, Shall.

Mean free path The average distance that a molecule travels between collisions with other molecules.

Medium frequency (sputtering) The frequency range of 20 to 250kHz. Often used in a dual target arrangement.

Metalizing (decorative coating) The least preferred spelling of metallizing.

Metallization (decorative) To apply a metal film, usually aluminum, to a low cost part—often a molded plastic or a zinc die-cast part. Also called **Junk coating**.

Metallization (electronics) Application of an electrically conductive film to a non-conductive surface.

Metallization (general) Application of a metal film to a surface.

Microcolumnar morphology (film formation) The morphology that develops with thickness due to the development of surface roughness due to preferential film deposition on high points on the surface. The columnar morphology resembles stacked posts and the columns are not single grains. Also called **Columnar morphology** (preferred). See Macrocolumnar morphology.

Microstructure (film) The crystallography, grain size, phase distribution, lattice defect structure, voids, etc., of a film as determined by using an analytical technique such as Transmission Electron Microscopy (TEM). See Morphology, film.

Microwave There is no sharp distinction between microwave frequency and radio frequency (rf) waves or infrared radiation but typically microwaves are in the 1 to 100 gigahertz (GHz) range with a wave length shorter than about 30 centimeters. A common industrial microwave frequency is 2.45 GHz.

Mid-frequency (sputtering) The AC voltage frequency range of 10-250 kHz used for AC sputtering usually in a dual cathode arrangement.

Molecular Beam Epitaxy (MBE) The epitaxial growth of a single-crystal film produced in a very good vacuum using a well-controlled beam of atomic or molecular species, which is usually obtained by thermal evaporation from an effusion cell. See Knudsen cell.

Molecule A group of atoms held together by chemical bonds and that has defined chemical properties. Often used in a context which includes atoms.

Momentum, particle A vector quantity equal to the mass (m) times the velocity (v) of the particle.

Monolayer (ML) A single layer of atoms or molecules on a surface in a close-packed arrangement.

Morphology, bulk (film growth) The properties of the bulk of the film that can be visualized by fracturing the material and then observing the morphology of the fracture surface**.**

Morphology, surface (film growth) The properties of a surface such as roughness, porosity, long and short-range features, etc., that can be seen using an optical microscope or Scanning Electron Microscope (SEM).

Mouse hole (film growth) Void left at the corner of the bottom of a trench during film deposition due to the top closing before the bottom is filled. Caused by geometrical shadowing. See Keyholing.

Movchan Demchishin (MD) diagram (film growth) Structure zone model of atomistically deposited vacuum condensates. See Structure Zone Models (SZM).

Multi-layer film (PVD technology) A film structure that contains two or more discrete layers of two or more different materials. Many layers can be formed by alternating deposition between vaporization sources. Examples: An X-ray diffraction grating of W-C-W-C-W, and Ti-Pd-Cu-Au metallization. Also call a **Stack**.

N

Nanometer (nm) A unit of length equal to 10^{-9} meters or10 Ångstroms.

Nanoparticles Clusters of several thousand atoms formed by collisions of vaporized atoms with gaseous atoms. Also called **Smoke**, **Soot, Nanoclusters,** or **Ultrafine particles.** See Gas Evaporation.

Nanophase material Dense, ultrafine-grained material, often formed by atomistic vaporization processess, that has a high percentage (up to 50%) of its atoms at grain boundaries. Also called **Nanostructured material**.

Near-surface region (ion bombardment) Region near the surface that is below the penetration region of the ions but which is affected by the bombardment by heating diffusion, etc. See Altered region.

Near-surface region (surface analysis) The region near the surface that is penetrated by the probing species or that generates the detected signal that is analyzed.

Negative glow region (plasma) The bright region at the edge of the dark space in a DC glow discharge.

Negative ion A particle that has one or more excess electrons.

Neutralization (electrical) The removal of an electrical charge by the addition of charges of the opposite sign. Example: surface charge neutralization. See Beam neutralization.

Neutralizer filament (ion gun, plasma source) An electron emitting filament used to inject electrons into the ion beam that has been extracted from an ion gun, in order to eliminate "space charge blowup" of the ion beam. Essentially changes the ion beam into a plasma beam.

Noble species An elemental species that has filled valence electron shells and thus is relatively chemically inert (e.g., He, Ne, Ar, Kr, Xe, Au). See Inert gas.

Nodule, film (film growth) A visual mass of material that has a different appearance, microstructure and/or morphology than the rest of the film material.

Non-reactive deposition (film deposition) Deposition where the material that is deposited is the same as the material that is vaporized. Usually performed in a vacuum or inert gas environment

Normal glow discharge A DC glow discharge in the pressure range that the current density on the cathode (**Cathode spot**) is constant with pressure changes. See Abnormal glow discharge.

Nucleation (film formation) The stage of film formation where isolated nuclei are being formed on the substrate surface before the film becomes continuous.

Nucleation, de-wetting growth When nuclei on a surface grow by adatoms avoiding the surface and the nuclei growing primarily normal to the surface. Example: Gold on carbon. See Wetting growth.

Nucleation, homogeneous Uniform nucleation (nucleation density) over the whole surface.

Nucleation, inhomogeneous Nucleation density varies from place-to-place on the surface.

Nucleation, wetting growth The lateral growth of nuclei on a surface due to the strong interaction of the adatoms with the surface. See De-wetting growth.

Nucleation density (film formation) The number of nuclei per unit area on the substrate surface.

Nucleation sites, preferential (film formation) Positions on a surface that have a high chemical reactivity and will react with mobile adatoms more readily than most of the surface. The site may be due to chemistry or morphology. Example: Steps in the surface providing a high coordination at the base of the step; inclusion of tin in one surface of float glass.

Nuclei, condensation (film formation) The grouping of mobile atoms (adatoms) on a surface to form a stable structure. Stable nuclei can range in size from a few atoms (strong chemical bonding between the atom and the surface) to many atoms (weak interaction).

O

Optical emission (plasma) The emission of radiation from a plasma due to de-excitation of excited species.

Optical emission spectroscopy Technique of measuring the optical emission from a plasma. Used to determine the species and density of particles in a plasma.

Optical pyrometry Determination of the temperature of a surface by observing its color temperature, usually by comparing its color to the color of a surface at a known temperature. See Infrared pryometry.

Oxygen plasma cleaning (cleaning) Cleaning in an oxygen plasma where the contaminant is oxidized and vaporized.

P

Parameter window (manufacturing) The limits to a process variable, such as temperature, between which an acceptable product will be produced.

Particle, fine (cleaning) A particle whose diameter is less than 2.5 microns (EPA definition).

Particle, ultrafine (cleaning) Particle having a diameter less than about 0.5 microns. Generally formed by vapor phase nucleation or the residue from the evaporation of an aerosol. See Vapor phase nucleation.

Particulate contamination (cleaning) Contamination by particulates. A major source of pinholes in thin films either by geometrical shadowing or by holes generated when the particle is dislodged from the surface.

Passivation Producing a surface layer on a material that decreases its reaction with the ambient. Passivation can be accomplished by removing a reactive species from the surface (ASTM A380), increasing the thickness or density of a naturally-forming oxide, by chemically reacting the surface to form a passive compound or by overlay techniques where the passivation layer consists of a different material.

Penning ionization (plasma) Ionization of an atom by collision with a metastable atom in an excited state which is of higher energy than the ionization energy of the first atom. Example: Ionization of copper (ionization energy = 7.86 eV) by excited argon (metastable excited states of 11.55 and 11.75 eV).

Periodic deposition (film formation) 1) When a film of a compound material is formed by periodically depositing a very thin metal film, then reacting the film with a gaseous reactant, and then repeating the process many times to build up the film thickness. Example: The MetaMode™ deposition process. 2) When a multilayer film structure is formed by depositing many alternating layers of different materials using a fixture that exposes the substrate to first one, then the other material. Example: Alternating layers of tungsten and carbon for an X-ray diffraction grating. Also called **Alternating plating.**

Physical sputtering (PVD technology) Often called just **Sputtering**. The physical ejection (vaporization) of a surface atom by momentum transfer in the near-surface region by means of a collision cascade resulting from bombardment by an energetic atomic-sized particle.

Physical Vapor Deposition (PVD) The deposition of atoms or molecules that are vaporized from a solid or liquid surface. See Chemical Vapor Deposition (CVD).

Pilot production Production to evaluate a process flow using full-scale equipment or equipment that can be scaled-up to meet production throughput requirements.

Pinhole (film formation) A small hole in the film due to incomplete coverage during film growth or from flaking (Pinhole flaking). See Porosity, film.

Pinhole flaking (contamination control) Flaking from film build-up on surface aspirates producing particulate contamination in the deposition system.

Planar magnetron (sputtering) A magnetron configuration where the target surface is a planar surface and the magnetic field is in a configuration that the oval sputter-erosion track resembles a "racetrack." See Magnetron.

Plasma A gas that contains an appreciable number of electrons and ions such that it is electrically conductive.

Plasma, augmented A plasma whose electron density has been increased by the addition of electrons from an external electron source such as a hollow cathode.

Plasma, auxiliary A plasma separate from the main processing plasma. For example, an auxiliary plasma is needed near the substrate to activate the reactive gas in reactive magnetron sputtering where the main plasma is confined away from the substrate.

Plasma, equilibrium A plasma that is volumetrically neutral.

Plasma, low-density A plasma that has a low particle density.

Plasma, strongly ionized A plasma where most of the gaseous particles are ionized.

Plasma, weakly ionized A plasma in which only a small percentage (e.g., 0.01%) of the gaseous particles are ionized and the rest of the particles are neutral.

Plasma activation (film formation) Making gaseous species more chemically reactive in a plasma by excitation, ionization, fragmentation or by the production of new chemical species. See Reactive deposition.

Plasma Assisted CVD (PACVD) See **Plasma Enhanced CVD (PECVD)**.

Plasma cleaning (cleaning) Cleaning using a plasma environment. The cleaning action can be from desorption (inert gas plasma) or chemical reaction and volatilization (reactive gas plasma).

Plasma deposition Formation of a film by the use of a plasma to decompose or polymerize a precursor gas or vapor. See also Plasma polymerization, Plasma Enhanced Chemical Vapor Deposition (PECVD).

Plasma duct (arc vaporization) A filtered arc source where the plasma is magnetically deflected so that the macros are deposited on the wall of the duct. See Arc source.

Plasma Enhanced CVD (PECVD) Chemical vapor deposition where a plasma is used to assist in the decomposition and reaction of the chemical vapor precursor allowing the deposition to be performed at a significantly lower temperature than when using thermal processes alone. Example: PECVD of phosphosilicate glass (PSG) encapsulating glass at 450°C in semiconductor processing. See Reinberg reactor, Very Low Pressure CVD (VLP-CVD).

Plasma generation region The region in which free electrons and ions are generated.

Plasma Immersion Ion Implantation (PIII) A process in which a metallic substrate is immersed in a plasma and pulsed momentarily to a high potential (50-100 kV). Ions are accelerated to the surface from the plasma and before there is an arc-breakdown, the pulse is terminated.

Plasma parameters (plasma technology) Important plasma parameters are: electron density, ion density, ion charge state distribution, density of neutral species, electron temperature, ion temperature and average particle temperature. Uniformity of the plasma parameters from place-to-place in the plasma can be important in plasma processing.

Plasma potential The potential of the plasma with respect to a surface in contact with the plasma which may be grounded, floating or electrically insulating. The plasma potential will always be positive with respect to any large-area surface that it is in contact with.

Plasma-deposited films Films deposited from a plasma using a chemical vapor precursor gas or a monomer as a source of the deposited material. See Plasma polymerization, Plasma enhanced CVD, Chemical ion plating.

Pocket (e-beam evaporation) The cavity in the water-cooled copper hearth that holds the material to be evaporated in electron beam evaporation. See Liner.

Poisoning, target (sputtering) Reaction of the surface of a sputtering target either with the reactive gas being used for reactive deposition or with a contaminant gas. The reacted layer causes a change in the performance of the sputtering target.

Polypropylene (PP) (substrate) A polymer material that is used for webs and plastic containers. Less expensive than PET but has less desirable optical properties.

Porosity, film Open or closed porosity in the deposited film due to the mode of growth, substrate effects, void coalescence or pinhole flaking. See Columnar morphology, Macrocolumnar morphology.

Position equivalency When all positions on a fixture yield parts that are indistinguishable one from another or that lie within an acceptable range of property variation. If position equivalency is not established, the batch can have unacceptable variations in the properties of the coated parts.

Positive column (plasma) The field-free, luminous region in a DC gas discharge between the negative glow and the anode. The region that allows the use of gas discharges for linear illumination.

Post magnetron (sputtering) A magnetron configuration which is a post, perhaps with flares on the ends (spool), with a magnetic field either axial to the post or in a series of looped magnetic fields around the post. The electrons are confined along the surface of the post and between the flared ends. See Magnetron.

Postdeposition treatments (film formation) Treatments to change the properties of the film after deposition. Example: Topcoating, shot peening or burnishing to close porosity.

Postvaporization ionization (PVD technology) Ionization of the vaporized (sputtered or evaporated) film atoms to form **Film ions** that can be accelerated in an electric field. See Film ions.

Power, target (sputtering) The power (watts) or power density (watts/ cm^2) applied to the sputtering target. This process variable, along with gas pressure and gas composition, are the parameters most often used to control the sputtering and sputter deposition processes.

Precursor, chemical, liquid (CVD, PVD reactive deposition) A liquid which acts as the source of the depositing material by containing the elemental constituents of the coating which are released by heating, reduction, etc. The liquid is vaporized in a hot chamber and carried into the deposition chamber by a hot carrier gas. Example: $TiCl_4$ whose boiling point (b.p.) is 136.4°C as a source of titanium.

Precursor, chemical, vapor (CVD, PVD reactive deposition) A vapor (at room temperature) which acts as the source of the depositing material by containing the elemental constituents of the coating which are released by heating, reduction, etc. Example: SiH_4 as a source of silicon, C_2H_2 as a source for carbon.

Preferential evaporation When one constituent of an alloy vaporizes faster than another because of its higher vapor pressure at a specific temperature.

Preferential nucleation sites (film growth) Positions on a surface where the mobile adatoms prefer to condense. Example: Charge sites, atomic steps, interfaces; and lattice defects such as grain boundaries, substitutional atoms or emerging dislocations.

Preferential sputtering When one constituent of the surface sputters more rapidly than another, leaving a detectable surface enrichment of the low-sputtering-yield material. Note that this layer must be sputtered before the underlying material is exposed so the ratio of the constituents in the vapor is the same as that of the bulk material, even though there is surface enrichment.

Presputtering, target (sputtering) Sputtering a target with a shutter closed or with the substrates out of line-of-sight, to clean the surface of the target. Also called **Target conditioning**.

Process Flow Diagram (PFD) A diagram showing each successive stage in the processing including storage, handling and inspection. A PFD is useful in determining that there are MPIs that cover all stages of the processing.

Process parameter window The limits for each process parameter between which a good product is produced. See Robust process.

Process parameters The variables associated with the process that must be controlled in order to obtain a reproducible process and product. Example: Time, temperature, target power, gas pressure, etc.

Process sheet The process sheet which details the process parameters of the deposition run. Also called a **Run sheet**. See Traveler.

Product throughput The number of units produced per unit time.

Properties, film Properties of the film that are determined by some specified technique.

Properties, film, functional Properties that are essential to the desired function of the film such as sheet resistance for conductivity, optical reflectance for mirrors, etc.

Properties, film, stability Properties that influence long-term performance such as corrosion resistance, residual film stress, etc.

Pseudodiffusion-type interface (film formation) An interfacial region where the material is graded, similar to the diffusion interface, produced by mechanical means such as beginning the second deposition before stopping the first deposition, or by implantation of high energy "film ions."

Pulsed DC A DC waveform that has a voltage that is less than the cycle time and the rest of the cycle being at zero potential. See Direct current, Bipolar DC.

Pulsed Laser Deposition (PLD) Deposition using laser ablation as the vaporization source. See Laser vaporization.

Q

Quasi-reactive deposition (PVD technology) Deposition of a compound from a compound source where the loss of the more volatile species is compensated by having a partial pressure of reactive gas in the deposition environment. Example: Quasi-reactive sputter deposition of ITO from an ITO sputtering target using a partial pressure of oxygen in the plasma. See Reactive deposition.

R

Rack Structure to hold parts for processing, such as cleaning or electroplating, outside the deposition system. See Fixture.

Racking or "to rack" To mount the parts into a rack or fixture (i.e., "to rack them"). See Un-rack.

Radiant heating (film deposition) Heating of a surface by radiation from a hot surface. Example: Heating of a substrate from a quartz lamp in vacuum.

Radiation equation An equation that provides the intensity of radiation from a hot surface. The radiant energy E from a hot surface is given by $E = \partial T^4 A$ where ∂ is the emittance of the surface, T is the Kelvin temperature and A is the area of emitting surface.

Radiation shield An optical baffle that is used to contain radiation or prevent radiation from reaching a surface.

Radio frequency (rf) An alternating potential (AC) within a certain frequency range. There is no sharp distinction between radio waves and microwaves but typically rf frequencies start at about 50 kHz and extend to 100 MHz with 13.56 MHz being a common industrial rf frequency. See Audio frequency, Microwave frequency.

Radio frequency (rf) sputtering Physical sputtering, generally of an electrical insulator, where the high negative electrical potential on the surface is achieved by alternately polarizing the surface positively and negatively at a rate greater than about 50kHz. During the positive half-cycle, surface charging is neutralized by electrons from the plasma. During the negative half-cycle, ions are accelerated from the plasma to sputter the surface. See AC sputtering.

Random arc (plasma) Cathodic arc where the arc is allowed to move randomly over the cathode surface. See Arc source.

Raoult's Law (evaporation) Raoult's Law states that constituents of a liquid vaporize at a rate proportional to their vapor pressures.

Re-sputtering rate (ion plating) The rate of sputtering of the depositing film material due to the concurrent energetic particle bombardment of the growing film. Example: About 20 to 40% resputtering is necessary to completely disrupt the columnar morphology of the depositing film material.

Reactant availability (reactive deposition) The availability and chemical reactivity of the reactive gas over the surface of the film being deposited. Since the surface of the film is continually being buried, reactive gas availability is an important parameter in reactive deposition process.

Reaction probability (reactive deposition) The probability that a reactive gas species impinging on a surface will react with the surface to form a compound. The probability depends on the reactivity of the species, residence time on the surface, surface coverage, surface mobility, reaction-enhancing processes such as concurrent electron or ion bombardment, etc.

Reactive deposition (film formation) Film deposition process in which the deposited species reacts with an ambient gas, an adsorbed species or a co-deposited species to form a compound material. See Quasi-reactive deposition.

Reactive evaporation (film deposition) Evaporation in a partial pressure of reactive gas in order to deposit a compound film material. See Reactive deposition.

Reactive plasma cleaning (cleaning) Reaction of contaminants with reactive species to form volatile compounds.

Reactively graded interface (film formation) A graded interface formed by changing the availability of the reactive gas during the formation of the interfacial region. Example: Grading the film composition from titanium to TiN_{1-x} to TiN by changing the availability of the nitrogen during reactive deposition.

Recoil implantation (cleaning, film formation) When a high energy bombarding species imparts enough energy to a surface atom to cause it to be recoil implanted into the lattice as an interstitial atom.

Recombination (plasma chemistry) The combining of a positive ion with an electron so as to form an uncharged species. This process mostly occurs on surfaces and the process gives up the ionization energy to the surface and the neutral species.

Redeposition When a material that has been vaporized, deposits on the surface from whence it came. Example: Backscattering in a gaseous environment.

Reflected high energy neutrals (sputtering) In the sputtering process, a portion of the high energy bombarding ions becomes neutralized and are reflected from the cathode (target) surface. If the gas pressure is low, these high energy particles are not thermalized and bombard the growing sputter-deposited film and influence film properties such as residual film stress.

Reinberg reactor (PECVD) A parallel-plate, rf-driven reactor for plasma enhanced CVD (PECVD). See Reactor, CVD.

Remote region (plasma) The **Afterglow** or **Downstream region**.

Rework To take a part that has been rejected in inspection and repair or redo the reason for the rejection.

Roll coater **See Web coater**.

Rotatable cylindrical magnetron (sputtering) A water-cooled tubular sputtering target containing a magnetron magnetic field arrangement such that the wall of the tube is rotated through the magnetic field producing uniform sputter-erosion of the whole surface of the tube. See Magnetron.

Run, deposition Each deposition process including pumpdown-deposition-letup to atmosphere. See Cycle (process).

S

Sculpted Thin Films Films grown with the columnar growth controlled by the varying the angle-of-incidence to give various shapes to the columns.

Second surface (optical) The surface of the optical substrate opposite the incoming radiation. Example: Second surface mirror which is metallized on the "backside" of the glass. See First surface.

Second surface coating (decorative coating) The reflective coating (usually aluminum) that is used underneath the lacquer coating. The lacquer coating (topcoat) is used to give color and texture to the coated part.

Seed (film formation) Defect in a deposited film due to particulate contamination of the growing film during deposition.

Seed layer (film formation) A layer, often close to one monolayer thick, that acts as a nucleating layer for subsequent deposition.

Selective deposition Deposition on a local area. May be due to masking, local areas of heating, nucleation sites or local application of electrolyte solutions (brush plating in electroplating).

Self-bias (plasma technology) An electrical potential on a surface generated by the accumulation of excess electrons (negative self-bias) or positive ions (positive self-bias). See Sheath potential.

Self-ion (sputtering, sputter deposition) An ion of the sputtered target material that can bombard the target giving **Self-sputtering**. See Film ion.

Self-sputtering Sputtering by an ion of the target material being sputtered. See Film ion.

Sensitization (surface) The production of unsatisfied chemical bonds on a surface which increase the chemical reactivity of the surface. Often sensitization is a temporary condition so the **Time-to-use** must be specified.

Serial co-sputtering (PVD technology) When material from one sputtering target is deposited onto another sputtering target from which it is sputtered to produce a graded or mixed composition.

Shall Term used in a Specification or Manufacturing Process Instruction (MPI) that indicates a mandatory procedure. Example: The gloves shall be discarded after each use. See May, Should.

Sheath potential (plasma) The potential across a sheath. Example: The potential across the wall sheath is typically a few eV with the plasma being positive with respect to the wall due to the higher mobility of the electrons as compared to the ions.

Should Term used in a specification or MPI that indicates a good practice but which is not mandatory. Example: Gloves should be discarded after use. See Shall, May.

Shutter (vaporization) A movable optical baffle between the vaporization source and the substrate that prevents contaminants from the source from depositing on the substrate during the initial heating of the source. The shutter also minimizes radiant heating of the substrate before vaporization begins. The shutter can also be used to establish the deposition time.

Single-unit processing (PVD technology) Processing one (or a small number of) units at a time in contrast to processing a number of units each cycle (Batch coating). Example: Processing compact discs one-at-a-time with a cycle time of less than 3 seconds.

Skin (sintered material, sputtering target) The dense surface layer that is sometimes formed on sintered materials.

Skull (evaporation) The solid liner that forms between a molten material and a surface. The skull may be due to cooling such as a molten material in contact with a water-cooled copper hearth or may be due to the formation of a reaction layer such as molten titanium in contact with a carbon liner giving a TiC skull.

Soot (CVD, reactive deposition) Ultrafine particles formed by gas phase decomposition (CVD) and nucleation. See Ultrafine particles.

Space charge The net charge in a volume of space caused by an excess of one charged species over another. Example: An excess of electrons and negative ions over positive ions will result in a negative space charge.

Specification, process The formal document which contains the "recipe" for a process and which defines the materials to be used, how the process is to be performed, the parameter windows and other important information related to safety, etc. Information on all critical aspects on the **Process flow sheet** should be covered by Specifications. See Process flow sheet.

Spit (evaporation) A molten droplet of the evaporant ejected from the molten surface. Spits generally result from vapor bubbles rising through the molten material. See Boiling beads.

Sputter cleaning (cleaning) Removal of surface material in the deposition chamber by physical sputtering. See *In situ* cleaning.

Sputter deposition (PVD technology, vacuum deposition processes) A physical vapor deposition process in which the source of the depositing atoms is a surface (target) being sputtered.

Sputtered (as in sputtered films) Poor terminology; it is better to use **Sputter deposited** films.

Sputtering, Alternating Current (AC) When two sputtering targets are electrically connected with each other such that when one target is the cathode the other is the anode with the polarity switching at a frequency of less than 50 kHz so each target is acting in a DC diode mode. This arrangement reduces the problems of the "**Disappearing anode effect**" when reactively depositing insulating film.

Sputtering, chemical The vaporization of surface atoms by chemical reaction with a reactive bombarding species resulting in an easily volatilized compound species. Example: Sputter etching of silicon using bombardment with chlorine ions. See Reactive plasma etching (RPE), Reactive ion etching (RIE).

Sputtering directed Sputter deposition where the sputtered species form a low-divergence beam before impinging on the substrate. The divergence can be colliminated by mechanical means, ionization and accleration, or by "long-throw" sputtering.

Sputtering, physical The physical ejection (vaporization) of a surface atom by momentum transfer in the near-surface region by means of a collision cascade resulting from bombardment by an energetic atomic-sized particle.

Sputtering, pulsed DC A diode configuration in which the negative potential is applied as a fast rise-time DC pulse with a zero or reverse potential for a short portion of each cycle. The negative pulse time can be 60 to 90% of the cycle time.

Sputtering, self Sputtering of metals using ions of the same material either originating from the sputtering target or for another source.

Sputtering configuration The geometry used for sputtering. See Magnetron, Deposition systems, Fixturing.

Sputtering configuration, conformal target When the sputtering target is conformal with the substrate geometry. Example: Hemispherical target sputtering onto a hemispherical surface. See Fixtures.

Sputtering configuration, movable target A sputtering configuration where the sputtering target is moved while the substrate remains stationary. Used when coating very large substrates.

Sputtering configuration, opposing targets When two or more (multiple of twos) planar unbalanced magnetrons face each other and the substrate is passed between the targets. The magnetic fields of the targets are such that the escaping magnetic field lines go from one target to another.

Sputtering efficiency (energy) The amount of energy that is represented by the ejected sputtered atom (vaporization energy plus kinetic energy) to the amount of energy put into the surface by the bombarding species. Sputtering has a very low energy efficiency compared to thermal evaporation.

Sputtering target (PVD technology) The material to be sputtered. Generally a cathodic surface in a gas discharge. See Target.

Sputtering threshold The minimum incident particle energy necessary to cause sputtering.

Sputtering yield The ratio of the number of atoms ejected to the number of high-energy incident ions in the sputtering process.

Steered arc (plasma technology) A cathodic arc where the arc is moved over the surface under the influence of a magnetic field. See Random arc.

Sticking coefficient (film formation) The ratio of the particles that remain on the surface to those striking the surface. Also called **Sticking probability.**

Stoichiometric compound A compound material which has the correct atomic ratios for all lattice sites to be occupied for the specific phase of the material. Example: CuO (1 : 1) or Cu_2O (2 : 1). See Sub-stoichiometric.

Stoichiometry The numerical ratio of atoms in a compound.

Stranski-Krastanov model (nucleation) Nucleation on a surface which changes structure during the initial deposition.

Structure Zone Model (SZM) (film formation) A diagram showing the morphology of a deposited film as a function of some deposition parameter. Example: Temperature for vacuum evaporation; gas pressure and temperature for sputter deposition. See Movchin-Demchishin diagram, Thornton diagram.

Sub-stoichiometric compound A compound that does not have the correct ratio of elements to have the most stable structure. Example: TiN_{1-x} or SiO_{2-x}. See Stoichiometric.

Sublimation (PVD technology) Thermal vaporization from a solid surface. See Evaporation.

Sublimation source (vaporization) A vaporization source for heating materials, such as chromium, that sublime rather than evaporate. The sublimation source can function best by ensuring good thermal contact between the heater and the solid. Example: Electroplated chromium on a tungsten heater or by heating by radiation in an oven-like structure, or by direct e-beam heating of the surface of the solid.

Substrate (PVD technology) Surface on which the film is being deposited. See Real surface.

Superhard materials Materials having a hardness greater than about 40 GPa. Examples are: diamond = 100 GPa and cubic BN = 40 GPa.

T

Target (sputtering) The surface being sputtered. Usually at a cathodic potential with respect to a plasma. Targets can be formed by machining, rolling, melting, vacuum melting, sintering, CVD, and plasma spraying.

Target, conditioning Removal of the surface contamination such as oxides and degassing the target material before the sputter deposition begins.

Target assembly, sputtering The component of the sputter deposition system that contains the sputtering target, the target backing plate (if used) and the target cooling assembly. See Backing plate, target.

Target bonding (sputtering) Joining the target to the backing plate with a high thermal conductivity bond. Bond can be inspected by thermal analysis or ultrasonic inspection. See Backing plate.

Target poisoning Reaction of the surface of a sputtering target either with the reactive gas being used for reactive deposition or with a contaminant gas. The reacted layer causes a change in the performance of the sputtering target.

Target shielding (sputtering) Shielding of the target to prevent establishing a plasma between the shield and the target. See Paschen curve.

Technology transfer The transfer of a product design and fabrication technology from Research and Development (R&D) into Manufacturing. This includes issues dealing with manufacturability and scale-up as well as the ability of individuals to communicate with each other both through written (formal) documents such as specifications and through informal and formal personal interactions (e.g. meetings).

Thermal vaporization (PVD technology) The vaporization of a material by raising its temperature. A useful vaporization rate for PVD processing is when the equilibrium vapor pressure is above about 2 mTorr. See Evaporation, Sublimation.

Thermalization (vacuum technology) The reduction of the energy of an energetic particle to the energy of the ambient particles by collision, as it passes through the ambient.

Thickness, geometrical (film characterization) The film thickness as measured in units of length. Examples: Microns, Ångstroms, mils, nanometers.

Thickness, mass (film characterization) The film thickness as measured by mass per unit area. Example: Micrograms per square centimeter ($\mu g\text{-}cm^{-2}$).

Thickness, optical (optical) The geometrical thickness multiplied by the index of refraction.

Thickness, property (film characterization) The thickness measured by some property of the film such as optical adsorption.

Thin film (PVD technology) There is no universally accepted definition of the term "thin film." Generally the term is applied to deposits having a thickness of less than several microns. The term can be used to describe surface layers that affect the optical, electrical or chemical properties of a surface and in some cases the thin film affects the physical and mechanical properties of a surface such as the abrasion resistance. Also called a **Strike** in electroplating. See Coating, Thick film.

Throwing power (PVD technology) The ability of a deposition process to cover a rough surface or deposit material in high aspect ratio (depth-to-width) surface features such as vias.

Tool (semiconductor processing) System for performing a process (e.g. sputtering tool). Used synonymously with equipment.

Tooling There is no universally accepted definition of the term "tooling" but it can be defined as the mechanical structure(s) in the deposition chamber that holds and moves the fixtures, vaporization source, shutters, masks, etc. Generally tooling is a non-removable structure in the system.

Tooling factor The ratio of the observed condition, using sensors, during processing to the measured condition after processing. Example: Ratio of the film thickness on a quartz crystal monitor, to the measured thickness of the film deposited on the substrate.

Topcoat (PVD technology) A film or coating that is put on a deposited film structure, generally by a separate process. Example: **Lacquer coating** on a deposited gold film to provide abrasion resistance.

Traveler (manufacturing) Archival document that accompanies each batch of substrates detailing when the batch was processed and the specifications and MPIs used for processing. The traveler also includes the **Process sheet,** which details the process parameters of the deposition run.

Trigger arc (arc vaporization) The high-voltage arc that is used to initiate the arc breakdown which is then sustained by the low-voltage, high-current arc.

Triode configuration (plasma) A plasma configuration where a plasma is established between a cathode and an anode, often with magnetic confinement, and ions are extracted out of the plasma to a third electrode which is at a negative potential with respect to the plasma. Used in triode sputtering configurations.

Tuning (plasma) Matching the impedance of the load to that of the power supply so as to couple the maximum amount of energy into the load (plasma).

U

Ultrafine particle (cleaning) Particle having a diameter less than about 0.5 microns. Generally formed by vapor phase nucleation of vaporized material or the residue from the evaporation of an aerosol. Also called **Nanoparticles**. See Vapor phase nucleation, Gas evaporation, Nanophase materials.

Un-rack To remove parts from a fixture. See Racking.

Unbalanced magnetron (sputtering) A magnetron configuration in which the magnetic fields are arranged so as to allow some of the secondary electrons to escape from the vicinity of the cathode to establish a plasma between the target and the substrate. See Magnetron.

V

Vacuum arc An arc formed in a vacuum such that all of the ionized species originate from the arc electrodes. See Gaseous arc.

Vacuum cadmium plating Vacuum deposition of cadmium on high strength steel to avoid hydrogen embrittlement of the steel which can occur in electroplated cadmium. Also used to avoid water pollution problems. Also called **Vac cad plating.**

Vacuum coating (thin film technology) Film deposited by a PVD process.

Vacuum deposition (PVD technology) Films deposited by thermal vaporization of a material in a vacuum so that particles that leave the source do not collide with gas molecules before they reach the substrate. Often used synonymously with **Vacuum evaporation**.

Vacuum evaporation (PVD technology, vacuum deposition processes) Thermal vaporization of a material in a vacuum so that particles that leave the source do not collide with gas molecules before they reach the substrate. Often used synonymously with **Vacuum deposition**.

Vapor A gas that is easily condensed by cooling, compression, etc. The term gas is often used in a context that includes vapors. See Gas.

Vapor Phase Epitaxy (VPE) (PVD technology) Formation of single crystal films by Chemical Vapor Deposition (CVD) processes. See Chemical Vapor Deposition (CVD).

Vapor phase nucleation The development (condensation) of nuclei in the gas phase due to multi-body collisions. See Ultrafine particles, Gas evaporation, Black sooty crap (BSC).

Vapor pressure, equilibrium The pressure of the vapor of a solid or liquid above the surface in a closed container such that as many particles return to the surface as leave the surface. Also called the **Saturation vapor pressure**.

Vaporization (volatilization) The conversion of a solid or liquid to a vapor by any means such as thermal, arcing, sputtering, etc.

Vapour **See Vapor** British spelling for vapor.

Very Low Pressure CVD (VLP-PECVD) Plasma Enhanced CVD at a pressure (<15 mTorr) where ions can be accelerated to appreciable energies. Often used in conjunction with a PVD process to give a hybrid process such as depositing a metal carbide by sputtering the metal and obtaining the carbon by PECVD from C2H2.

Void (film growth) A region lacking solid matter. The void may be internal with no connection to a free surface or it can be connected to a free surface. Also called a **Pore**.

W

Web (PVD technology) A thin, flexible membrane that may be solid or perforated.

Web coating (PVD technology) Depositing a film on a web of material, usually of a polymer or paper. Aluminum is a commonly deposited film material in web coating.

Wetting growth (film formation) The lateral growth of nuclei on a surface due to the strong interaction of the adatoms with the surface. See De-wetting growth.

Window, process parameter The region between the process parameter limits that allows a satisfactory product to be produced. The larger the window, the more robust is the process. Example: $100^{o}C \pm 10^{o}C$ - the window in $20^{o}C$.

Y

Yield, product The percentage of substrates that enter the production processing sequence that result in good product.

Yield, secondary electron The number of electrons emitted from a surface per incident electron or incident ion. The secondary electron yield for electrons is much higher than for ions.

Yield, sputtering The number of ejected (sputtered) surface atoms per incident high energy bombarding particle (ion).

A

A	Ampere
Å	Ångstrom
AAS	Atomic Adsorption Spectroscopy
ABS	Acrylonitrile-butadiene-styrene copolymer, alky-benzene-sulfonate detergent
ACGIH	American Conference of Governmental Industrial Hygienist
ACS	American Chemical Society
AEM	Analytical Electron Microscopy
AES	Auger Electron Spectroscopy
AESF	American Electroplaters and Surface Finishers
AFM	Atomic Force Microscopy, Abrasive Flow Machining
AIMCAL	Association of Industrial Metallizers, Coaters and Laminators, Inc.
AIP	American Institute of Physics
AMLCD	Active-Matrix Liquid Crystal Display
AMR	Anisotropic MagnetoResistive
ANSI	American National Standards Institute
AO	Atomic Oxygen
APC	Adaptive Process Control
AP-CVD	Atmospheric Pressure Chemical Vapor Deposition
APIMS	Atmospheric Pressure Ionization Mass Spectrometry
APS	American Physical Society
AR	AntiReflective
ARC	AntiReflective Coating
ARE	Activated Reactive Evaporation
ARIP	Activated Reactive Ion Plating
ARO	After Receipt of Order
ASHRAE	American Society of Heating, Refrigerating and Air-conditioning Engineers
ASIC	Application Specific Integrated Circuit
ASM	ASM International (Previously American Society for Metals now ASM International)
ASME	American Society of Mechanical Engineers
ASNT	American Society for Nondestructive Testing
ASQC	American Society for Quality Control
ASTM	American Society for Testing and Materials
AVEM	Association of Vacuum Equipment Manufacturers (AVEM International)
AVS	American Vacuum Society
α (**a**)	amorphous (Example: a-Si or α-Si)
amu	atomic mass unit
atm	atmosphere (usually standard atmosphere)
at%	atomic percent

B

B	Magneic field (vector)
BAG	Bayard-Alpert Gauge
BBAR	Broad Band Antireflection
BOPP	Biaxially oriented polypropylene
BP	(filter) Bandpass
BPSG	BoroPhosphoSilicate Glass
BRDF	(light) Bidirectional Reflectance Distribution Function
BSC	Black Sooty Crap
bcc	(crystallography) body centered cubic
bp	boiling point

C

C	Capacitance, Ceiling
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CAS	Chemical Abstract Service
CASS	Copper Accelerated Acetic Acid Salt Spray
CCAI	Chemical Coaters Association International
CCD	Charged-Coupled Devices
CCW	Counterclockwise
CD	Compact Disc; Critical Dimension; or Cross Direction
CDG	Capacitance Diaphragm Gauge
CDMS	Chlorodimethylsilane
CD-R	Compact Disc-Recordable
CEVC	Completely Enclosed Vapor Cleaner
CF™	ConFlat (vacuum flange)
CFC	Chlorofluorocarbon
CFC-111	Trichloroethane
CFC-113	Trichlorotrifluoroethane
CGA	Compressed Gas Association
CIE	Commission International de l'Eclairage (International Comimssion on Illumination)
CLA	Center Line Average
CLEO	Conference on Laser and Electro-Optics
CMM	Converting Machinery/Materials
CMOS	Complementary metal-oxide semiconductor
CMP	Chemical-Mechanical Polishing, Chemical-Mechanical Planarization
CN	Coordination Number
CNDP	Cold Neutron Depth Profile
COO	(or CoO) Cost Of Ownership
CPP	Cast Polyproplylene
CrP	Chromium-rich oxide Passivation
CRT	Cathode Ray Tube

CTE Coefficient of Thermal Expansion
CTMS Chlorotrimethylsilane
C-V Capacitance-Voltage
CVD Chemical Vapor Deposition
CW Clockwise
c velocity of light in a vacuum
cc cubic centimeter
cfm cubic feet per minute
cfs cubic feet per second
cgs centimeter-gram-second (system of units)
cm centimeter

D

D-CVD Dielectric-CVD
DCS Dichlorosilane
DI Deionized water
Diff Diffusion pump
DIO Deionized and ozonated (water)
DIW Deionized Water
DLC Diamond-Like-Carbon
DMS Dual Magnetron Sputtering
DMSO Dimethyl Sulfoxide
DOE Department of Energy (US), Design of Experiments
DOP Dioctyl Phthalate
DOT Department of Transportation
DOVID Diffractive Optically Variable Image Device
DP Diffusion Pump
DRAM Dynamic Random Access Memory
DTIC Defense Technical Information Center (USA)
DUV Deep UltraViolet
d Day
dwt pennyweight

E

E Emissivity, electric field (vector), exponential
EB (eb) Electron Beam
ECM ElectroChemical Machining
ECR Electron Cyclotron Resonance
ECS Electrochemical Society
EDM ElectroDischarge Machining
EDX Energy Dispersive X-ray
EDTA Ethylene Diamine Tetraacetic Acid
EELS Electron Energy Loss Spectroscopy
EHC Electrolytic hard chrome
EL Electroplated
ELD Electroluminescent Display (flat panel)
EMI Electromagnetic Interference
EN Electroless nickel
EPA Environmental Protection Agency
Epi Epitaxial
ERA Evaporative Rate Analysis
ERD Elastic Recoil Detection
ESCA Electron Spectroscopy for Chemical Analysis
ESD ElectroStatic Discharge
emf electromotive force
epi epitaxial
eV electron volt

F

F Farad
FC Fault Classification
FD Fault Detection
FDD Floppy Disc Drive
FEC Field Emission Cathode
FED Field Emission Display, Field Emission Diode
FE-SEM Field Emission—Scanning Electron Microscopy
FET Field Effect Transistor
FLIR Forward Looking InfraRed (7.5 to 12 μm)
FPC Fixed Process Control
FPD Flat Panel Display
FT-IR Fourier Transform Infrared Analysis
fcc face centered cubic
fpm feet per minute

G

G Giga (suffix for 10^9), unit of magnetic field strength (gauss), Gallons
GANA Glass Association of North America
GDMS Glow Discharge Mass Stectrometry
GDOES Glow Discharge Optical Emission Spectroscopy
GFSI Ground Fault Circuit Interrupter
GPM Gallons Per Minute
g unit of gravitational acceleration, gram
gr grain

H

H Hour, Henry (unit of inductance)
HAP Hazardous Air Pollutants
HAZ Heat-affected zone, Hazardous (material)
HCD Hollow Cathode Discharge

HCL Hollow Cathode Lamp, hydrochloric acid
HDD Hard Disk Drive
HDP-CVD High Density Plasma CVD
HEED High Energy Electron Diffraction
HEPA High Efficiency Particle Air. See also ULPA.
HF Hydrofluoric acid
HFCVD Hot Filament Chemical Vapor Deposition
HFE Hydrofluoroether
HMC Hybrid Micro Circuit
HMCTSO Hexamethylcyclotrisiloxane
HMDSO Hexamethyldisiloxane
HVOF High Velocity Oxygen Fuel
HWOT Half Wave Optical Thickness
Hz Hertz (cycles per second)
h Planck's constant
hcp hexagonal close packed

I

IAD Ion Assisted Deposition
IARC International Agency for Research on Cancer (establishes carcinogenicy of materials)
IBA Ion Beam Analysis
IBAD Ion Beam Assisted Deposition
IBED Ion Beam Enhanced Deposition
IBEST™ Ion Beam Surface Treatment
IC Integrated Circuit
ICB Ionized Cluster Beam (deposition)
ICP Inductively Coupled Plasma
ICP-MS Inductively Coupled Plasma Mass Spectrometer
ID Internal Diameter
IDLH Immediately Dangerous to Life or Health
IDM Integrated Device Manufacturing
IEEE Institute of Electrical and Electronic Engineers
IES Institute of Environmental Sciences
ILD InterLayer Dielectric
IMD InterMetal Dielectric
IMEMS Integrated Microelectromechanical Systems
IPA IsoPropyl Alcohol
IPC Institute for Interconnecting and Packaging Electronic Circuits
ISHM International Society for Hybrid Microelectronics
ISO International Standards Organization
ISS Ion Scattered Spectrometry
ITO Indium-tin-oxide alloy (90 : 10)
IVD Ion Vapor Deposition
IWFA International Window Film Association
I-PVD Ion-assisted Physical Vapor Deposition
I-V Curent - voltage

J

J Joule, electric current (vector)
JVST Journal of Vacuum Science and Technology

K

K dielectric constant, Karat (fineness of gold)
k kilo (suffix for 10^3), Boltzman's constant, portion of the complex index of refraction given by n-ik or n (1-ik), optical extinction coefficient ($k=\alpha\lambda/4\pi$)
kcal kilocalorie
kGy KiloGray
kWH kilo-watt-hour

L

L Low (carbon steel), Liter (preferred)
LASER Light-Amplification by Stimulated Emission of Radiation
LC_{50} Median lethal dose
LCD Liquid Crystal Display
LCM Laser Confocal Microscope
LCVD Laser Chemical Vapor Deposition
LDPE Low Density Polyethylene
LED Light Emitting Diode
LEED Low Energy Electron Diffraction
LLDPE Linear Low Density Polyethylene
LM Layer Metallization
LOCOS Local Oxidation of Silicon
LP-CVD Low Pressure Chemical Vapor Deposition. See also SA-CVD.
LPPS Low Pressure Plasma Spray
LIMA Laser-Induced Mass Analysis
LLS Linear Least Squares (statistical analysis)
LN and LN2 Liquid Nitrogen
LPCVD Low Pressure Chemical Vapor Deposition
LTEL Long Term Exposure Limits
LTS Long throw sputtering
LWP Long Wavelength Pass filter
l liter (not preferred)

M

M mega (prefix for 10^6), Minute
MBE Molecular Beam Epitaxy
MCrAlY Metal-Chromium-Aluminum-Yitterium

MD Movchan-Demchiskin, Machine Direction
MDG Molecular Drag Gauge
Me Metal
Me-C:H Metal-containing hydrocarbons
MEC Methylene Chloride
MEMS Microelectromechanical Systems (also called MST)
MERIE Magnetically Enhanced Reactive Ion Etcher
MF Mid-Frequency
MFC Mass Flow Controller
MFM Mass Flow Meter
MFSA Metal Finishing Supplier's Association
ML Monolayer
MLAR Multi-Layer Antireflection Coating
MLS Monolayers per Second
MMIC Monolithic Microwave Integrated Circuits
MNS Metal-nitride-silicon
MO Magneto-Optical
MOCVD Metal-Organic Chemical Vapor Deposition
MOS Metal-Oxide Semiconductor
MPI Manufacturing Process Instruction
MR Magnetoresistive
MRS Materials Research Society
MSDS Materials Safety Data Sheet
MST Microsystems Technology (also called MEMS)
MT-CVD Medium Temperature Chemical Vapor Deposition
MTR Material Test Report
MVTR Moisture Vapor Transmission Rate
m milli (suffix for 10^{-3}), molality
mcg micrograms
min minute
mks meter-kilogram-second

N

NACE National Association of Corrosion Engineers
NAMF National Association of Metal Finishers
NBS National Bureau of Standards, which has been renamed NIST
NC Normally closed
NDE Non-Destructive Evaluation
NDT Nondestructive Testing
NEG Non-Evaporable Getter
NESHAP National Emission Standards for Hazardous Air Pollutants
NFPA National Fire Protection Association
NIST National Institute of Science and Technology (USA)
NO Normally open
NPB N-propyl Bromide
NREL National Renewable Energy Laboratory
NVR Non-Volatile Residues
n Index of refraction, portion of the complex index of refraction given by n-ik or n(1-ik)
nm nanometer

O

OD Optical Density; outside diameter
ODP Ozone Depletion Potential
OEM Original Equipment Manufacturer
OES Optical Emission Spectroscopy
OLED Organic Light Emitting Devices
OPP Oriented Polypropylene
OS Ozone safe
OSEE Optically Stimulated Electron Emission
OSHA Occupational Safety and Health Administration (USA)
OTR Oxygen Transmission Rate
OVID Optically Variable Image Display
OXTR Oxygen Transmission Rate
oza or oz(a) Avoirdupois ounce
ozt or oz(t) Troy ounce

P

P Suffix used to denote plasma deposited material. Example P-TEOS.
Pa Pascal
PA Polyamide
PACVD Plasma Assisted Chemical Vapor Deposition
PAPVD Plasma Assisted Physical Vapor Deposition
PAVD Plasma Assisted Vapor Deposition
PCE Perchloroethylene
PD Plasma Doping
PDP Plasma Display Panel
PECVD Plasma Enhanced Chemical Vapor Deposition
PEEK Polyethyletherketone
PEI Polyetherimide
PEL Permissible Exposure Limits
PEM Plasma Emission Monitor
PERC Perchloroethylene
PET Polyethylene Terephthalate (polyester)
PF Packing Fraction
PFC Perfluorocompounds
PFD Process Flow Diagram
PFPE Perfluorinatedpolyether
PIII Plasma Immersion Ion Implantation

PLD Pulsed Laser Deposition
PM Preventive Maintenance
PML Polymer Multilayer
PMS Pulsed Magnetron Sputtering
PO Purchase Order
POU Point of Use
PP Polypropylene
PSG PhosphoSilicate Glass
PVA Polyvinyl Alcohol
PVC PolyVinyl Chloride
PVD Physical Vapor Deposition
PVDC Polyviniylidene chloride
PWB Printed Wiring Board
PZT LeadZirconateTitanate ($PbZrTiO_3$)
p parallel (Example: p wave)
pH Pouvoir Hydrogene
poly polycrystalline
ppm Parts per million.
ppmbv Parts per million by volume
psi Pounds per Square Inch
psia Pounds per Square Inch — Absolute
psig Pounds per Square Inch — Guage

Q

Q charge in coulombs
QA Quality Assurance
QC Quality Control
QCM Quartz Crystal Monitor
QWOT Quarter Wavelength Optical Thickness

R

R Resistance, organic radical in chemical nomenclature
R_a Roughness (average)
R_{max} Roughness (maximum)
R_s Sheet resistance, Spreading resistance
RAM Random Access Memory
RBS Rutherford Backscattering Spectrometry
RED Reflection Electron Diffraction
RFI Radiofrequency Interference
RFQ Request for Quotes
RGA Residual Gas Analyzer
RH Relative Humidity
RHEED Reflection High Energy Electron Diffraction
RIBE Reactive Ion Beam Etching
RIE Reactive Ion Etching
RMOS Refractory Metal-Oxide Semiconductor
RO Reverse Osmosis
ROM Read-Only Memory
ROW Rest of World
RPE Reactive Plasma Etching
RT Room Temperature
RTA Rapid Thermal Annealing
RTCVD Rapid Thermal CVD
RTN Rapid Thermal Nitridation
RTP Rapid Thermal Processing
RTSPC Real Time Statistical Process Control
rf radio frequency
rms root mean square
rpm revolutions per minute
rps revolutions per second

S

SA-CVD Sub-Atmospheric CVD
SAD Selected Area Diffraction
SAE Society of Automotive Engineers
SAMPE Society for the Advancement of Materials and Processing Engineering
SAW Surface Acoustic Wave
SCBA Self Contained Breathing Apparatus
SCM Scanning Capacitance Microscope
SCSI Small Computer Systems Interface
SEAM Scanning Electron Acoustic Microscope
SEI Secondary Electron Image
SEM Scanning Electron Microscopy
SEMI Semiconductor Equipment and Materials International
SI International System (system of units)
SIAM Scanning Interferometric Aperatureless Microscope
SIMOX Separation by Implanted Oxygen
SIMS Secondary Ion Mass Spectrometry
SION Silicon oxynitride
SIP Sputter Ion Plating
SIS Semiconductor-Insulator-Semiconductor
SLAM Scanning Laser Acoustic Microscope
SLAR Single Layer Aintireflection
SMART Self-Monitoring, Analysis and Reporting Technology
SME Society of Manufacturing Engineers
SMIF Standard Mechanical Interface
SMT Surface Mount Technology
SNMS Secondary Neutral Mass Spectrometry
SOD Spin-On-Dielectric
SOG Spin-On-Glass

SPC	Statistical Process Control
SPE	Solid Phase Epitaxy
SPIE	International Society for Optical Engineering
SQUID	Superconducting Quantum Interference Device
SRAM	Static Random Access Memory
SRG	Spinning Rotor Gauge
SRM	Standard Reference Material
SS (SST)	Stainless steel
SSIS	Surface Scanning Inspection Systems
SSMS	Spark Source Mass Spectrometry
STEL	Short Term Exposure Limits
STEM	Scanning Transmission Electron Microscopy
SThM	Scanning Thermal Microscopy
STI	Shallow Trench Isolation
STM	Scanning Tunneling Microscopy
STP	Standard Temperature (0°C) and Pressure (760 Torr)
SVC	Society of Vacuum Coaters
SWP	Short Wavelength Pass filter
SZM	Structure-Zone-Model
s	second, perpendicular (as in s-wave)
sccm	standard cubic centimeters per minute
sccs	standard cubic centimeters per second
scf	standard cubic feet
scm	standard cubic meters
sg	specifc gravity
slm	standard liters per minute
std	standard

T

TA	Thermal analysis
TAB	Tape Automated Bonding
TA-MS	Thermal Analysis with Mass Spectrometry
TC	Thermocouple, Thermocompression
TCA	1,1,1-trichloroethane (or methyl chloroform)
TCC	Transparent Conductive Coating
TCE	Trichloroethylene ($CHCl:CCl_2$), Thermal Coefficient of Expansion
TCLP	Toxicity Characteristic Leaching Procedure
TCO	Transparent Conductive Oxide
TCP	Transformer-Coupled Plasma
TCR	Temperature Coefficient of Resistivity
TD	Transverse Direction
TEM	Transmission Electron Microscopy
TEOS	Tetraethoxysilane
TFI	Thin-Film Inductive
TFT	Thin Film Transistor
TGA	Thermogravimetric analysis
TGA-MS	ThermoGravimetric Analysis with Mass Spectrometry
TIS	Total Integrated Scatter
TiW	(W:10wt%Ti) or (W:30at% Ti) (alloy)
TLV	Threshold Limit Values
TMDSO	Tetramethyldisiloxane
TMP	Turbomolecular Pump
TMS	Tetramethyldisiloxane (TMDSO preferred)
TSHT	Total Solar Heat Transmittance
TWA	Time Weighted Average
TWM	Thermal Wave Microscopy
TZM	Alloy of titanium, zirconium and molybdenum
t:aC	Tetrahedral amorphous carbon

U

UBM	Unbalanced Magnetron
UCHF	Ultra-Clean High Flow
UF	Ultra-Filtration
UHP	Ultra-High Purity
UHV	Ultra-High Vacuum
ULPA	Ultra-Low Permeation Air. See also HEPA.
ULSI	Ultra-Large Scale Integration
uPVC	Unplasticized Polyvinyl Chloride
UPW	Ultra-Pure Water
USPTO	US Patent and Trademark Office
UTS	Ultimate Tensile Strength
UV	Ultraviolet
u	unified atomic mass unit

V

V	volt; Voltage (as in CV measurements)
VAR	Vacuum Arc Remelting
VCR	Voltage Coefficient of Resistance
VEPA	Very-high Efficiency Particulate Air (filter)
VHV	Very High Vacuum
VIM	Vacuum Induction Melting
VLP-PECVD	Very Low pressure Plasma Enhanced Chemical Vapor Deposition
VLR	Visible Light Reflection
VLT	Visible Light Transmission
VOC	Volatile Organic Compounds
VOD	Vacuum Oxygen Decarburization
VPE	Vapor Phase Epitaxy
VUV	Vacuum UltraViolet
v	velocity

W

W	watt
WDM	Wavelength Dispersive Multiplex
WDX	Wavelength Dispersive X-ray
WORM	Write Once Read Many
WVTR	Water Vapor Transmission Rate
wt%	weight percent

X

XES	X-ray Energy Spectroscopy
XPS	X-ray Photoelectron Spectroscopy
XRD	X-Ray Diffraction
XRF	X-Ray Fluorescence
XRM	X-Ray Microanalysis
XRT	X-Ray Topography
XUHV	Extra UltraHigh Vacuum

Y

Y	Young's Modulus

Z

Z	Atomic number of an element
ZAO	Aluminum-doped Zinc Oxide
ZD	Zero Defects

Miscellaneous

α	optical adsorption coefficient (cm^{-1}); amorphous
Ω	ohm
μ	micron
μm	micrometer
ν	frequency
λ	Wavelength
i	Prefix used to indicate that the film was formed using beam-type film-ion deposition. Example: i-C, i-BN.
N	Normal

Other Glossaries

ASTM Standard E 673-86a "Definitions of Terms Relating to Surface Analysis"

"Scientific Unit Convesion", Francois Cardarelli. Springer-Verlag (1997)