

# Glossary

A B C D E F G H I L M N O P R S T V W

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## A

### **ALD**

Atomic Layer Deposition (ALD) is a method for producing ultra-thin films for semiconductor devices and new, emerging non-semiconductor applications. ALD is a technology that is capable of meeting the production requirements of next-generation geometries (45 nanometer and below). The ALD process is used to pulse and purge two reactants to deposit films. In the purge process carrier gases like argon or nitrogen are employed.

### **AVD®**

Atomic Vapor Deposition (AVD®); a liquid delivery and evaporation technology. Liquid precursors or precursor solutions are sprayed directly into the flash vaporizer via injectors. Up to four injectors – one for each precursor source – can be used.

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## B

### **Backlighting**

The assemblies used to illuminate the liquid-crystal displays (LCDs) of electronic equipment are known as "backlighting" assemblies. LEDs are used for backlighting because their advantages – long operating lifetime, robustness and small dimensions – are all of particular benefit. Displays for small mobile equipment such as mobile phones or navigation DEVICES are typical examples of applications.

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## C

### **Capacitor**

A capacitor is a circuit element formed by placing an insulating layer between two conducting layers; its function is to store an electrical charge. It is a very important component of memory chips.

### **Capital market**

The capital market is part of the financial market and is the entirety of all institutions and transactions whose purpose is to combine supply and demand for long-term (financial) capital.

### **Carbon nanotubes**

Carbon nanotubes (CNT) are microscopically small tube-shaped structures of carbon (molecular nanotubes). Depending on the structural detail, the electrical conductivity within the tubes is either metallic or semiconducting. There are also carbon nanotubes with superconducting properties at low temperatures. Transistors and simple circuits have already been produced using semiconducting carbon nanotubes.

### **Carrier gas**

In the process for the production of compound semiconductor layers or silicon devices, the raw materials are converted into gases and transported into the reactor with the help of a carrier gas. Carrier gases most commonly used are hydrogen, argon and nitrogen.

### **Chip**

The finished device structure which constitutes a very small element of the semiconductor wafer.

### **Clean room**

In a clean room area of a semiconductor fab, all wafer processing is completed. Dust and particles which might fall on the wafers during processing and result in the circuits not functioning correctly are kept out of the clean room by filtering the air and managing the air flow. Personnel are required to wear specially designed clean room overalls and "booties" over their street clothes and shoes, and must wear gloves and face masks (humans tend to shed skin and hair). Not even normal paper is allowed in clean rooms – only clean room low particulate paper may be taken in.

### **Close coupled showerhead®**

With this technology, the reagent gases are introduced vertically into the reactor through a water-cooled showerhead surface covering the entire area of deposition. During deposition, the showerhead is extremely close to the substrates and is constructed to enable precursors to be kept separate right up to the point where they are injected into the reactor chamber. The gases are injected through a multiplicity of small tube orifices into the chamber in order to create a very uniform distribution of reagent gases.

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## **CMOS**

Complementary Metal Oxide Semiconductor (CMOS) is a major class of integrated circuits. CMOS technology is used in CHIPS such as microprocessors, microcontrollers, static RAM, and other digital logic circuits. CMOS technology is also used for a wide variety of analog circuits such as image sensors, data converters, and highly integrated transceivers for many types of communication devices.

## **Compliance**

Compliance (including regulatory compliance) stands for the observance of laws and company policies, but also of voluntary codes. The totality of the principles, processes and measures of a company to comply with certain rules and thus to avoid breaking the rules in a company is called Compliance Management System and is a part of the Corporate Governance system.

## **Compound semiconductors**

These multi-element semiconductors are complex crystal growth structures containing a variety of material elements. The structures are defined by the periodic table groups from which they come. For example: IV/IV (germanium/silicon), III/V (gallium/nitrogen), II/VI (magnesium/ oxygen). Compound semiconductors have several advantages compared to single element semiconductors. Many have properties that allow them to emit or absorb light very efficiently (for illumination or production of electrical energy). Many can be processed into devices that have better power capabilities, operation frequency or efficiency than similar devices made from silicon only.

## **Corporate Governance**

Corporate Governance refers to the system by which companies are directed and controlled. Effective Corporate Governance guarantees that an enterprise is managed in a responsible, professional and transparent manner with the purpose of safeguarding its long-term success. It is intended to reflect and serve the purposes of the organization itself, its owners and all other stakeholders. Corporate Governance is very complex and includes both mandatory and voluntary measures: observance of legal provisions and policies (compliance), conformance with recognized standards and recommendations as well as the development of the company's own guidelines and adherence to them.

## **CVD**

Chemical Vapor Deposition (CVD) is the deposition of thin films (usually dielectrics/insulators) on silicon wafers placed in a reactor chamber or furnace. The target deposition material is delivered to the surface of the wafer in the form of a mixture of gases which then react at the surface of the wafers. CVD can be done at medium to high temperature in a furnace, or in a CVD reactor in which the wafers are heated but the walls of the reactor are not. Plasma enhanced CVD avoids the need for high temperature by exciting the reactant gases into a plasma.

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# **D**

## **Deposit/Growth**

Semiconductor devices comprise of several crystalline layers. Deposition is the correct term for the creation of these layers on a wafer.

## **Deposition**

Deposition describes the process by which material carrying gases are introduced into the reactor chamber where the required crystal growth or deposition process occurs on the wafers. Depending on the kind of coating process, different electronic and optoelectronic devices can be manufactured, e.g. LEDs, lasers, solar cells or transistors.

## **Devices**

These are the completed products which are manufactured with the compound or silicon semiconductor chips at their core. For example, LEDs and lasers, transistors, memory and logic chips, as well as solar cells.

## **Diode**

A two-terminal electronic device which permits significant current flow in only one direction. Diodes typically function as a rectifier, i.e. converting alternating current into direct current.

## **Display**

A display is an electronic device for displaying images and text. Displays can be found in many industrial and consumer electronic products, e.g. in digital cameras, cell phones or navigational equipment, as well as in flat screen televisions.

## **DRAM**

Dynamic Random Access Memory (DRAM) is a volatile type of semiconductor memory chip, on which data is lost after an interruption of the electric power supply.

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# **E**

## **Electronic paper**

Electronic paper (also e-paper, E-Paper or ePaper) aims to imitate printed paper. Displays of so-called E-Book Readers (EBR) reflect light in the same way as common paper devices do. Static digital information such as texts or pictures can be displayed semi-permanently and does not require any additional energy whilst being viewed. The image can be changed at any time and requires only a small energy input to be changed. Some methods allow the production of electronic paper displays which are nearly as flexible and thin as common paper devices.

**Epitaxy**

The deposition of thin single crystalline layers on a suited substrate in the form of crystal growth.

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**F****FeRAM**

FeRAM (Ferroelectric Random Access Memory) is a nonvolatile computer memory chip. It is similar in construction to DRAM, which is currently the most commonly used main memory in computers. FeRAM is based on a ferroelectric layer whose memory state is still retained even after switching off the power supply. At the same time it allows operating speeds that come close to those of DRAMS.

**Flash Memory**

See NAND flash memory.

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**G****Gas Foil Rotation®**

Gas Foil Rotation® (GFR) means that the wafer carriers in AIXTRON MOCVD equipment turn friction-free on gas cushions. This movement is powered by a directed gas flow.

**General lighting**

General lighting is the uniform, even illumination of a space. The term "solid state lighting" is also used in this context: Today this is what all semiconductor-based lighting components are called. They include LEDs and OLEDs, among others.

**German Commercial Code**

The German Commercial Code (HGB) contains the core of the commercial law of Germany.

**German Securities Trading Act**

The German Securities Trading Act (WpHG) regulates securities trading in Germany and serves in particular the control of the service industry, that deals with securities and financial futures, but also the protection of the investor.

**German Stock Operation Act**

The German Stock Corporation Act (AktG) regulates the setting up, incorporation, accounting, liquidation, and stockholders' meetings of stock corporations and partnerships limited by shares.

**Glovebox**

The hermetically sealed reactor cabinet with arm-length gloves in which the operator can slide his hands in order to carry out internal work from outside the cabinet. These cabinets protect the reactor from contamination with oxygen or humidity and ensure the purity of the epitaxial process.

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**H****HBT**

The Heterojunction Bipolar Transistor (HBT) is an improvement of the bipolar junction transistor, using differing SEMICONDUCTOR materials for the emitter and base regions and creating a heterojunction, that can handle signals of very high frequencies up to 600 GHz and more. This type of device is common in modern ultrafast circuits as well as applications requiring a high power efficiency, such as power amplifiers in cellular phones.

**HEMT**

High Electron Mobility Transistor (HEMT) is a field-effect transistor incorporating a junction between two materials with different band gaps. A commonly used material combination is GaAs with AlGaAs. HEMTs have attracted attention due to their high-power performance capabilities, especially for high frequency applications.

**HVPE**

Hydride Vapor Phase Epitaxy (HVPE) is a technique employed to produce semiconductors e.g. III-V compound semiconductor materials from metallic sources of group III elements and hydrogen compounds of group V elements of the semiconductor crystal. Also see VPE.

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## I

### **ISO 9001**

ISO 9001 is part of a series of standards that document the principles for quality management measures within a company. This standard describes the entire quality management system as a model and is the basis for a comprehensive quality management system.

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## L

### **LCD**

A Liquid Crystal Display (LCD) fulfills the same function as a monochrome or color television tube, namely as a display. LCD displays are very thin and energy-saving.

### **LED**

A light-emitting diode (LED) is an electronic semiconductor device. LEDs can emit very bright light and are highly energy-efficient. The most commonly used LEDs generally have an area of 0.1 mm<sup>2</sup> (ca. 20 mA) whereas the most powerful LEDs can have an area of 1 mm<sup>2</sup> (ca. 350 mA) or more. This places LEDs among the world's smallest light sources and their low power consumption and heat emission qualities make LEDs potentially far more economical and safer than traditional lighting.

### **Logic chip**

The critical chip which does the necessary computational calculations in an electronic component. For example, the main chip in a computer is a microprocessor, for mathematical computations, amongst other things.

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## M

### **Memory chip**

A chip which retains the information that logic chips will then process. For example, in a computer, the memory chips will store the word processing program while it is being used, and the letters of the word processing documents which are being worked on. DRAM is the type of memory used most in computers, and is by far the most important type of memory from a total worldwide revenue standpoint.

### **MOCVD**

Metal-Organic Chemical Vapor Deposition (MOCVD) is a compound semiconductor production method where the raw material "metal-organic compounds" are transformed into gases and then, bound to a carrier gas, are subsequently fed into the reactor. This transformation also occurs under reduced pressure, down to approximately one-tenth of normal atmospheric pressure. The advantage is that the gases being introduced are of high purity and can be finely dosed. MOCVD allows the processing of quite large surface areas and therefore is the first choice for the production of compound semiconductors. AIXTRON is one of the global market leaders in this technology.

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## N

### **NAND flash memory**

A non-volatile computer memory manufactured in NAND (Not/AND) technology. Flash memories are characterized by the fact that they can be electrically erased and reprogrammed. This technology is mainly used for memory cards. The data of a flash memory device is retained even after interruptions in the power supply.

### **Nanometer**

One nanometer (nm) is equal to one billionth of a meter and is approximately 70,000 times thinner than a human hair.

### **Nanotechnology**

The term "nanotechnology" refers to the research being conducted in cluster- and surface physics, semiconductor physics, specific areas of chemistry such as surface chemistry, and to a more limited extent, in areas of mechanical engineering and food technology ("nano food"). The collective term is derived from the magnitude common to all of the research areas, namely, structures with sizes ranging from a single atom to 100 nanometers (nm). Nanomaterials play an increasingly important role in the miniaturization of circuit elements. Typical nanotech material structures are the so-called "quantum dots". Modern processors also have structures smaller than 100nm, which could therefore also be called "nanotech" as well.

### **NASDAQ**

NASDAQ ("National Association of Securities Dealers Automated Quotations") is a stock exchange founded in 1971 as a fully electronic platform. Securities trading on NASDAQ is regulated by the United States Securities and Exchange Commission (SEC).

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### **Non-volatile memory**

A non-volatile memory device is a semiconductor memory device which will not lose its data even after its power source is switched off. This is in contrast to volatile memory (e.g. DRAMs), which loses its data when the power supply to the chip is interrupted.

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## **O**

### **OLED**

Organic Light Emitting Diode: An OLED is a solid state device that typically consists of a series of organic thin films sandwiched between two thin film conductive electrodes. The choice of organic materials and the layer structure determine the device's performance features: emitted color, operating lifetime and power efficiency.

### **OVPD®**

Organic Vapor Phase Deposition (OVPD®) is a technology for the thin film deposition of small molecular organic materials. It utilizes the advantages of gas phase deposition, where the materials are transported to the SUBSTRATE by an inert carrier gas.

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## **P**

### **PCRAM**

This abbreviation stands for Phase Change RAM and refers to a type of non-volatile memory in electronics. The active principle of this memory is based on the differences in electrical resistivity exhibited by the material depending on whether it is in the amorphous phase (high resistivity/reset state) or the crystalline phase (low resistivity/set state). The material used is a chalcogenide alloy (chalcogenide compound) similar to the material used for data storage in a CD-RW or DVD-RAM – also on the basis of phase change.

### **PECVD**

Plasma-Enhanced Chemical Vapor Deposition or also Plasma Assisted Chemical Vapor Deposition (PECVD) is the term for a special type of Chemical Vapor Deposition (CVD) process used to deposit thin films by chemical reaction, as with the CVD technique. In addition, the process is supported by a plasma. The plasma can burn directly in contact to the substrate to be layered (direct plasma method) or in a separate chamber (remote plasma method).

### **Periodic system**

All elements are ordered within the periodic table according to their atomic number and chemical properties into main- and subgroups. MOCVD technology uses elements like gallium arsenide (GaAs), indium phosphide (InP), gallium nitride (GaN) and related alloys. They are also called "III-V semiconductors" because they are elements of group III and V of the Periodic Table and can interact to form crystalline compounds.

### **Planetary Reactor®**

The Planetary Reactor® is based on the principle of a horizontal laminar flow reactor. The laminar flow principle guarantees extremely precise heterojunctions and unequalled control of deposition rates at the atomic monolayer level. The combination of this principle with AIXTRON's unique multiple substrate carrier rotation methodology, known as Gas Foil Rotation® (GFR), ensures excellent deposition uniformity, regarding layer thickness, composition and doping. In addition, the special reactor inlet, which allows the separation of reactive gases, ensures a uniform outward radial flow and optimum distribution adjustment.

### **Planetary rotation**

A specific arrangement of the wafers within an MOCVD reactor for the production process, whereby a number of small discs holding the wafers orbit like planets in space around the central gas injector (Gas Foil Rotation®). The large plate, where those small discs lie on, also turns. This method facilitates a uniform, even deposition of compound semiconductor layers on the wafer. AIXTRON employs this process as part of its MOCVD technology (Planetary Reactor®).

### **Prime standard**

As a sub-segment of the Regulated Market with additional requirements for admission, organized under private law and regulated by legislation, the Prime Standard is the segment of the Frankfurt Stock Exchange with the highest transparency standards, surpassing those of the General Standard. Admission to Prime Standard is a prerequisite for shares to be included in the DAX®, MDAX®, TecDAX® and SDAX® indices.

### **PVPD®**

Polymer Vapor Phase Deposition (PVPD®) is a technological process that is used e.g. in the production of electronic paper.

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## R

### **RFID chips**

Radio-frequency identification (RFID) is the use of an object (typically referred to as an RFID tag) applied to or incorporated into a product, animal, or person for the purpose of identification and tracking using radio waves. This contact-free technology makes the capture and storage of data considerably easier.

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## S

### **Sarbanes-Oxley Act**

The Sarbanes-Oxley Act of 2002 (also SOX) is a United States federal law designed to improve the reporting reliability of companies that make use of the public capital market of the United States.

### **Semiconductor**

A material such as silicon whose conductivity lies between that of a conductor and an insulator. Its conductivity can be modulated by adding impurities (such as boron or phosphorus in silicon).

### **Silicon**

An element of the periodic table with the symbol Si. Silicon is a semiconductor used to fabricate most transistors and integrated circuits.

### **Substrate**

A substrate is the base material on which semiconductor layers are deposited, see also wafer.

### **Susceptor**

This circular plate serves as the pocket holder for the substrate or the substrate carrier. Normally it consists of graphite so that excellent temperature uniformity can be achieved.

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## T

### **TecDAX®**

The TecDAX® is a German stock market technology index. Along with those in the DAX®, the MDAX® and the SDAX®, the companies in the TecDAX® are listed in the prime standard.

### **TFT**

A thin-film transistor (TFT) is a special field-effect transistor that allows the production of electronic circuits with large areas, e.g. on glass screens, backlit by LEDs. It is increasingly used in laptops, computer monitors and televisions.

### **Transistors**

These devices are divided into two types: the field-effect transistor is based on the effect that, by means of a voltage applied through an insulated terminal (gate), a current can be controlled between two terminals (source and drain). In the case of a bipolar transistor, the current is controlled between the two terminals by means of a small current at the base. This current controls the current flow between the two other terminals, referred to as emitter and collector.

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## V

### **VPE**

This is an older, established process for the production of compound semiconductors. In contrast to MOCVD, this gas phase process exclusively uses inorganic substances as starting materials. The method allows for clean deposits of very thick and pure layers. However, not all materials can be produced by this method. This method (also referred to as HVPE – Hydride VPE) has gained much attention as a way to produce high quality gallium nitride substrates or templates.

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## W

### **Wafer**

The technical term for the substrate material (e.g. silicon), typically a thin disc of semiconductor material, on which the layers are deposited in the reactor. The diameter of wafers is typically 2 inch, 100, 150, 200 or 300 mm.

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