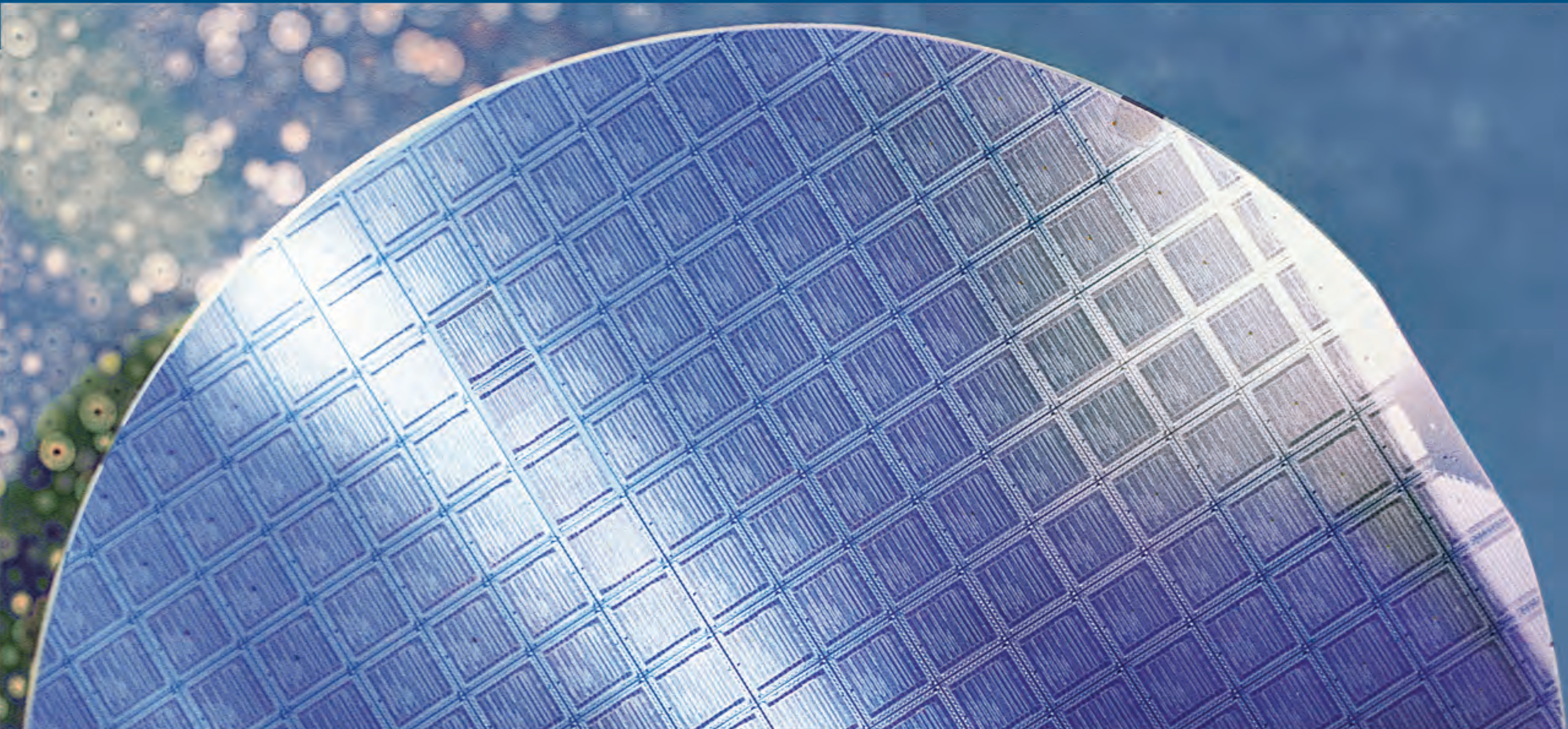
mks

Technology for Productivity

PROCESS SOLUTIONS FROM MKS . . .

Chemical Vapor Deposition



CHALLENGES OF CVD

Chemical Vapor Deposition (CVD) is a chemical process in which precursor gases are introduced into a reaction chamber at near ambient temperatures and directed towards a heated substrate in order to induce controlled chemical reactions. The chemical reactions result in the deposition of a solid thin film material onto the substrate surface.

Plasma Enhanced CVD (PECVD), a very common deposition technique, introduces a plasma into the process chamber in order to allow for deposition to occur at substrate surface temperatures that are significantly lower than those required for traditional CVD.

Reducing substrate temperatures broadens the range of deposition applications and reduces the challenges of CVD. Additional benefits of PECVD include higher deposition rates than standard CVD, wider range of film composition adjustment and improved control of film density and film stress. PECVD is the primary deposition method used to deposit low-k thin film dielectrics.

Tight control of CVD processes is critical to attaining the desired deposition conditions and film quality required to obtain high yields and low costs. The electrical characteristics, dielectric strength for insulating films, and resistivity for conducting films are critical to chip performance. Physically, the film thickness, step coverage and uniformity are also very important. The deposited film must be free of chemical and particle contamination, as well as pinholes and cracks.

MKS is the leading manufacturer of many components required to meet these difficult challenges. We have a long history of providing effective solutions for the most demanding processes and delivering subsystems that maximize yield and throughput.

COMMON TYPES OF CVD

Atmospheric Pressure CVD **(APCVD)**	Low Pressure CVD **(LPCVD)**	Plasma Enhanced CVD **(PECVD)**	High Density Plasma CVD **(HDPCVD)**
APPLICATIONS			
• Low-temperature oxides • Undoped silicon glass • Doped oxide in – Interlayer dielectric – Planarization – Epitaxial layer deposition	• Barriers and etch stops • Liners - stress relief between films • High temperature deposition of – Oxides – Silicon nitride – Poly-Si – Tungsten	• Insulators over metals • Nitride passivation • Low-k dielectrics • p-MOS gate conductor passivation • Source/drain implant stop • Pre-metal dielectrics • Inter-metal dielectrics – Gap fills – Damascene interconnect	• Shallow trench isolation filling • High aspect ratio gap fill • Pre-metal dielectric • Inter-metal dielectric – Gap fills – Damascene interconnect
ADVANTAGES			
• Simple reactor design • High deposition rates • Low temperature	• Excellent purity • Excellent uniformity • Good step coverage • Large wafer capacity • Greater control of thickness and resistivity	• Low temperature • High deposition rates • Good step coverage • Better film composition adjustment • Wider control of film density and film stress	• Low temperature • High deposition rates • Good step coverage • Better film composition adjustment • Control of film density and film stress • Improved gap fill • More planarization • Denser film
DISADVANTAGES			
• Particle contamination • Gas phase reactions • Poor step coverage	• High temperature • Slow deposition rate	• Chemical and particle contamination • Low film density • Film "cusping" at sharp corners pinching off deposition into high aspect ratio features	• Plasma induced film damage • Process complexity

Chemical Vapor Deposition

SUREPOWER® RF PLASMA GENERATOR

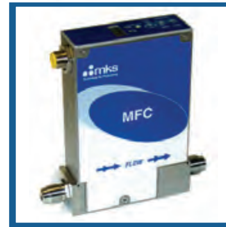
RF power for superior plasma generation and control in an integrated, compact package

- Forward power accuracy of ±1% of set point ensures repeatable process performance and greater yields
- Protection circuitry limits reflected power allowing the amplifier to survive adverse load conditions such as plasma transients and arcs

AX8407 HIGH CONCENTRATION OZONE GENERATOR

Compact, high concentration, ultra-clean ozone generator

- Concentrations up to 18.5wt% and flow rates from 10 to 40 slm provide improved process control and shorter cycle times
- Extremely low levels of dopant gas reduce contaminants improving yield and process repeatability



P-SERIES DIGITAL MFCs and PRESSURE CONTROLLERS

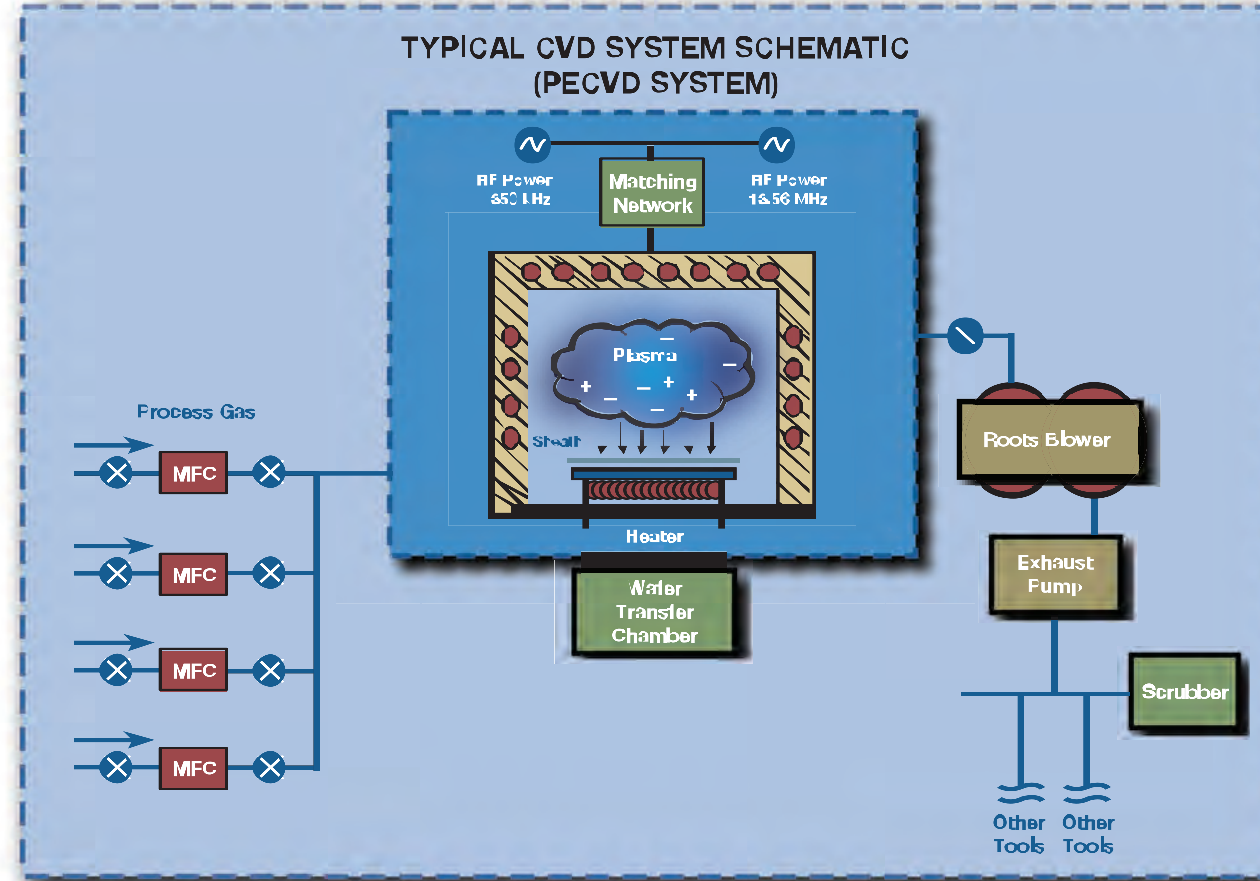
Real-time mass flow control and delivery of CVD process gasses and accurate process pressure control

- Exceptional pressure control accuracy for better film uniformity
- Multi-gas, multi-range capability for process compatibility and reduced inventory
- 500ms response for precise pressure control

FabStat REAL-TIME MONITORING, PREDICTION AND FAULT DETECTION

Real-time fault detection and classification (FDC) in semiconductor manufacturing

- Stand-alone application designed to seamlessly integrate into your existing fab data management system
- Reduces downtime by quickly identifying faults, their cause, and their solution



628C BARATRON® PROCESS MANOMETER

Accurate and reliable measurement of CVD process chamber pressures

- High measurement accuracy tightens the process window ensuring superior process control and repeatability
- Embedded diagnostics for reliability and control

901P MICROPIRANI™ / PIEZO LOADLOCK TRANSDUCER

Absolute vacuum pressure measurement from 1x10^{-5} to 1000 Torr

- Multi-sensor technology provides accurate and repeatable performance over a wide measurement range for improved process cycle control
- Gas independent pressure measurement from 50 to 1000 Torr provides a true indication of loadlock pressure for all purge gases eliminating time lost waiting for fully vented loadlock chambers to display atmosphere

VISION 2000-C™ PROCESS MONITOR

Continuous in situ monitoring of CVD processes

- Effective qualification of new CVD process tools or process sequences reduces time-to-production and time to ramp
- Detection of subtle changes in low concentration species and high mass species decay for improved process control
- Effective baseline monitoring of CVD chambers for air leaks and background contamination levels for increased yield and throughput

ASTRON®i REACTIVE GAS GENERATOR

Remote source of reactive gas species for CVD process chamber cleaning

- High gas flows reduce clean times and improve productivity
- Alternative gas capability increases process flexibility
- Reduces cost of ownership

PROCESS SENSE™ IR-BASED GAS MONITOR

Chamber clean endpoint detection for CVD process chambers

- Optimizes clean time for improved throughput and lower gas consumption
- Reduces chamber erosion from over-clean, extending the life of the chamber
- Reduces overall cost of ownership

EFFLUENT MANAGEMENT SOLUTIONS

Effective management of CVD by-products and system contaminants

- Minimizes cross-chemical reactions and prevents sublimation and clogging in pump and lines for reduced maintenance costs and longer uptime
- Prevents backstreaming of particles for greater process reliability and higher yields

mks
Technology for Productivity

PROVEN TECHNOLOGY LEADERSHIP

MKS Instruments is the world's leading supplier of process control solutions that improve productivity in semiconductor and related advanced manufacturing. Our extensive range of instruments, components and integrated subsystems, control and manage critical parameters of the process environment.

Today, our core competencies include pressure measurement and control, materials delivery, vacuum technology, gas composition monitoring, power and reactive gas generation, and control and information management. Our wide range of products, intellectual property and years of process applications experience allow us to provide an exceptional level of value. This unique technological breadth gives us the ability to identify process challenges and provide you with value-added process control solutions.

MKS' technology set is fundamental to meeting the requirements of advanced and leading edge technologies like CVD. Extensive process knowledge, proven technology leadership, and a strong patent portfolio make MKS well suited to provide CVD OEM's and end-users with high value solutions that optimize process performance, reduce costs and provide greater ROI.

GLOBAL SUPPORT

As a worldwide leader in the development and manufacture of advanced instruments and controls for the semiconductor industry, we can support your MKS products. Our service engineers average 7-10 years of industry experience. Service plans include extended warranty, contracts, calibration, 24/7 telephone support and industry-leading training. With 17 calibration and service centers in 13 countries around the globe, we are where you are.

ENHANCED PRODUCT PORTFOLIO FROM MKS

MFV Mass Flow Verifier
Compact diagnostic instrument that accurately measures and verifies mass flow

T3P Series Pendulum Valve
Integrated isolation and pressure control system

T3Bi Intelligent Exhaust Throttle Valve
Integrated pressure control for CVD applications

Jalapeño Series Heater Vacuum Valves
Isolates process chamber and vacuum system while eliminating turbulent pumpdowns

Heater Jackets, Traps and Effluent Management Solutions
Eliminates condensation and reduces system contamination

2 Tech Drive, Suite 201
Andover, MA 01810

Tel: 978.645.5500
Tel: 800.227.8766 (in USA)
Web: www.mksinst.com

MicroPirani™, Vision 2000-C™, and Process Sense™ are trademarks; and Baratron®, ASTRON® and SurePower® are registered trademarks of MKS Instruments, Inc. Andover, MA.

© 2006 MKS Instruments, Inc.
All rights reserved.