ANNEALSYS

Annealsys designs and manufactures

Rapid Thermal Processing (RTP)

Chemical Vapor Deposition (CVD, ALD)

systems for research laboratories and companies for semiconductor, MEMS, nanotechnologies and photovoltaic applications.

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- RTP: Rapid Thermal Processing
- RTCVD: Rapid Thermal Chemical Vapor Deposition
- DLI-CVD: Direct Liquid Injection Chemical Vapor Deposition
- DLI-ALD: Direct Liquid Injection Atomic Layer Deposition
- Spray CVD: Chemical Vapor Deposition with aerosol
- LPCVD: Low Pressure Chemical Vapor Deposition

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Company overview

Founded in May 2004

Franck Laporte, President
Jean-Claude Duchayne, Managing Director
Jean-Manuel Decams, R&D Manager

The company is privately owned

Annual turnover 4 M$

Location: Montpellier - France

la Région Languedoc Roussillon

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Annealsys team

Franck Laporte
Franck Laporte founded Annealsys in 2004. He is the president and CEO of the company. Franck Laporte graduated from ENSMM and also holds a master degree in Electronics. He was formerly founder, president and CEO of Jipelec and has 25 years background in development of Rapid Thermal Processing and Chemical Vapor Deposition systems especially RTCVD, LPCVD, UHV-CVD and MOCVD.

Jean-Claude Duchayne
Jean-Claude Duchayne is co-founder and CFO of the company. He is also responsible for purchasing and production. He graduated from the University of Toulouse as chartered accountant. He has served as CFO in various companies of the semiconductor industry including groups of SMEs, Jipelec and Qualiflow. He has an experience of auditor, purchasing manager, production manager and financial manager.

Jean-Manuel Decams
Jean-Manuel Decams holds a Ph.D in Chemistry in synthesis of chemical precursors for CVD from the University of Nice. He is R&D Manager at Annealsys and responsible for process development and cooperation research projects. He has been involved in many development projects for superconductor, metals and high-k materials deposition by MOCVD. He holds several patents and is associated to number of publications. He is co-inventor of state of the art direct liquid injection vaporization systems

Albin Diranzo
Albin Diranzo is a former automation engineer of Advanced Semiconductor Materials (ASM), a leading global supplier of semiconductor equipment. He has been involved in the development of a broad variety of furnaces for the semiconductor industry as well as gas control cabinets for optical fiber manufacturers. Albin Diranzo has joined Annealsys in 2005 to enforce the team. Albin Diranzo is now holding the position of sales manager.

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History of the company

2004 Franck Laporte et Jean-Claude Duchayne founded Annealsys

RTP systems
AS-One 100
AS-One 150

2005

AS-Master
200 mm RTP

AS-Micro
3-inch RTP

2006 Launch of development of DLI-CVD machines
MC100 prototype

LC100
LPCVD 4"

Annealsys represents FHR in France

2007

SprayCVD

2009

Annealsys represents Cambridge NanoTech ALD systems in France

2012

MC050 system
DLI-ALD/CVD
+RTP

MC200
DLI-ALD/CVD

2014

InCVD
joint laboratory
with CNRS-INL

AS-One 200

High temperature RTP furnace (2000°C)

Collaborative research programs

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Worldwide support

Worldwide sales and service support

Customers in 37 countries

America
- Georgia Tech,
- GE Global Research
- Intel
- MIT
- Nasa Glenn Research Center
- Naval Research Laboratory
- Sandia National Laboratory
- University of Virginia
- University of West Virginia
- University of Toronto
- University Simon Fraser
- Cinvestav, Cimav
- CNEA Argentina

Europe
- Anadolou University
- Arcelor Mittal
- CEA Grenoble
- CSIC IMB, CNM Barcelona
- CNRS (IEMN, LAAS, Phase)
- CRP Gabriel Lippmann
- EMPA
- IBM Research
- IMEC
- IMT Bucharest
- Institute of Electrical Engineering
- Jenoptik Diode Lab
- LETI Saint Petersburg
- Middle East Technical University
- MST.Factory
- NCSR Demokritos
- Northumbria University
- Plansee Metall GmbH
- Robert Bosch
- Ruhr University of Bochum
- RSE
- Sharp Laboratories of Europe
- SINTEF
- South Bank University
- Tekniker Eibar
- Thales
- Tyndall Institute
- Universitat de Valencia
- Universität Karlsruhe
- Université de Lyon
- Universiteit Hasselt
- University of Bath
- University of Göttingen
- University of Leeds
- University of Nottingham
- University of Oslo
- Vishay
- ZSW

Asia
- AIST
- Chinese Academy of Science
- Data Storage Institute
- Gal-El
- Fudan University
- IGCAR , IIT Chennai, IIT Mumbai
- Istanbul Teknik Üniversitesi
- Hebrew University Jerusalem
- Huawei Technologies
- Murata, Melco
- National Physical Laboratory
- NCKU
- NTU-Temasek, NTU
- Osaka Prefecture University
- Postech
- Promos
- Showa-Denko
- Sumitomo Denko
- Toyoda Gosei
- Toyota R&D
- Tokyo Electron R&D
- Tokyo University
- Solid State Physic Laboratory
- TMEC
- Tsinghua University
- University of Western Australia

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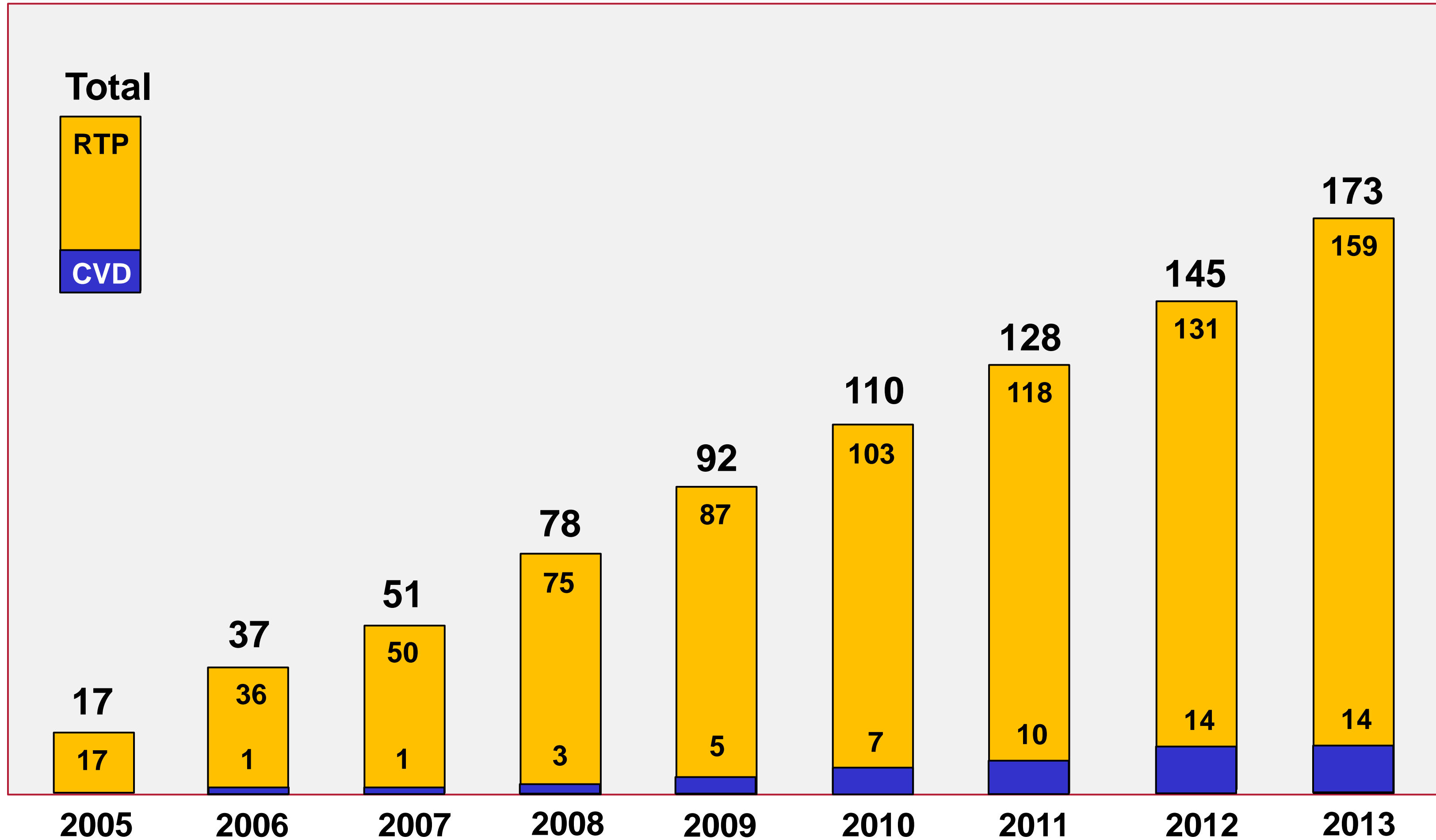
Systems in the fields



Research cooperation

Pro-CIGS

Development of production equipment for CIGS solar cells

CEA-DRT-LITEN, Alliance Concept and Annealsys

Metrograph

Development of graphene based quantum resistance

Laboratoire Charles Coulomb (LC2), Commissariat à l'Energie Atomique (CEA), Laboratoire National d'Essais (LNE), Laboratoire de Photonique et Nanostructure (LPN), LPMMC and Annealsys

SPEED

SPEED (Silicon carbide power electronics technology for energy efficient devices)

INAEL, ABB SCRC, CSIC-CNM, ENEL, Univ. Bremen, Univ. Oviedo, Norstelab, Ascatron, Univ. Nottingham, Infineon Technologies, Infineon Technologies Austria, TU München, Fraunhofer IISb, CVUT Praze, LU Hannover, Ingeteam and Annealsys

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DLI-ALD / DLI-CVD development

Joint laboratory InCVD

Joint laboratory (InCVD) with Institut des Nanotechnologies de Lyon (INL) supported by the French National Research Agency (ANR)

Development of new materials, integration of functional oxides on semiconducting and on graphene platforms, using the DLI-CVD/ALD equipments developed by Annealsys.

The scientific, technical and innovation program will focus on:

i) the improvement of the CVD/ALD processes
ii) the development of innovative materials in thin films and heterostructures
iii) their integration in devices for nanoelectronic and energy applications.

The InCVD laboratory is a development platform for the **demonstration of added-value materials and Annealsys reactors performance**. It is an opportunity for Annealsys to enhance expertise in CVD/ALD processes and to provide applications data to customers.

RTP Processes

- Implant annealing
- Contact annealing
- Rapid Thermal Oxidation (RTO)
- Rapid Thermal Nitridation (RTN)
- Diffusion of spin-on dopants
- Densification and crystallization
- Selenization
- Silicidation
- Etc.

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DLI-CVD / DLI-ALD Processes

Applications

- Simple and multi-metallic oxides
- Metals, nitrides and alloys
- III-V, wide band gap semiconductors
- Nanotubes and nanowires
- Etc.

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RTCVD & LPCVD Processes

- CVD of graphene in RTP furnace
- Carbon nanotubes in RTP furnace
- RTCVD: Poly Si, SiO_2, Silicon Nitride
- LPCVD: Poly Si, SiO_2, Silicon Nitride

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Substrate types

- Silicon wafers
- Compound semiconductor wafers
- GaN/Sapphire wafers for LEDs
- Silicon carbide wafers
- Poly silicon wafers for solar cells
- Glass substrates
- Metals
- Polymers and plastics
- Graphite and silicon carbide susceptors
- Etc…

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Products

- **AS-Micro:** 3-inch RTP system for R&D
- **AS-One:** 4 and 6-inch RTP systems up to 1500°C
- **AS-One 200:** 200 mm square chamber RTP system
- **AS-Master:** 200-mm RTP and RTCVD system

- **MC050:** 2-inch DLI-CVD/ALD system with RTP capability
- **MC100:** 4-inch DLI-CVD/ALD system for R&D
- **MC200:** 200 mm DLI-CVD/ALD system with plasma capability

- **SprayCVD-050:** 2-inch Spray CVD system
- **LC100 & LC102:** 4-inch LPCVD furnaces

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Main features of Annealsys RTP and RTCVD systems

- Stainless steel cold wall chamber
- Low Temperature measurement system
- Fast digital PID temperature controller
- Multi zone cross lamp furnace (AS-Master)
- Gas mixing capability
- Same software for all systems
- Optional turbo pump and pressure control

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RTP and RTCVD systems Technology advantages

Cold wall chamber:	**Less memory effects of the chamber** **Better process reproducibility** **Higher cooling rates** **Accurate temperature measurement and control** **No metallic contamination** **RTCVD capability**
Reactor design:	**Uniform gas distribution** **High vacuum capability**
Furnace design:	**High temperature capability** **Multi-zone control (200 mm systems)**

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AS-Micro

3-inch RTP system for laboratories

Features:

- Infrared halogen tubular lamp furnace with silent fan cooling
- Quartz tube chamber with water-cooled stainless steel flanges
- Room temperature up to 1250°C, up to 250°C/s
- Thermocouple control (optional pyrometer)
- Atmospheric and vacuum process capability
- Purge gas line with needle valve
- Up to 4 process gas lines with digital MFC
- PC control with Ethernet communication for fast data logging
- Optional turbo pump and pressure control

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AS-One

Versatile 4 & 6-inch RTP tool for R&D and low volume production

Features:

- Floor standing tool (reduced foot print)
- Infrared halogen tubular lamp furnace with silent fan cooling
- Stainless steel cold wall chamber technology
- Room temperature up to 1500°C
- Thermocouple and pyrometer control
- Atmospheric and vacuum process capability
- Purge gas line with needle valve
- Up to 5 process gas lines with digital MFC
- PC control with Ethernet communication for fast data logging
- Optional turbo pump and pressure control

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AS-One 200

200 mm RTP system
Multiple configurations

Features:

- Floor standing system
- Infrared lamp furnace on top, bottom or both sides
- Stainless steel square cold wall chamber
- Manual loading or cluster interface
- Room temperature up to 1300°C
- Thermocouple and pyrometer control
- Atmospheric and vacuum process capability
- Up to 8 process gas lines with digital MFC
- PC control with Ethernet communication for fast data logging
- Optional turbo pump and pressure control

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AS-Master

200-mm RTP and RTCVD tool
Up to 1500°C process capability
R&D to production

Features:

- Infrared multi zone lamp furnace with fan cooling
- Stainless steel cold wall chamber technology
- From room temperature to 1500°C, up to 200°C/s
- Thermocouple and pyrometer control
- Atmospheric and vacuum process capability
- Purge gas line and up to 6 process gas lines with digital MFC
- PC control with Ethernet communication for fast data logging
- Optional turbo pump and pressure control
- Manual loading, cassette to cassette and cluster tool versions

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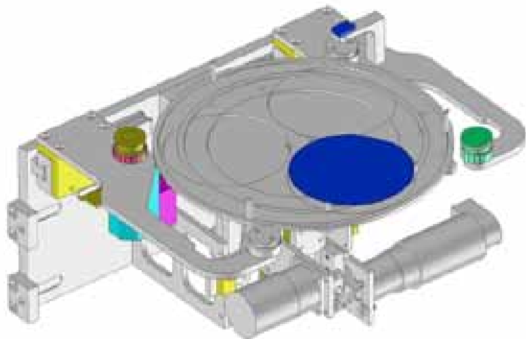
AS-Master

RTP tool for LEDs production

- InGaN annealing
- Contact alloying
- Sapphire , GaAs, InP
- 3x4” and 6” capability
- Automatic loading of susceptor



Extended pyrometer control range: 150°C to 1500°C

Full automation for multi substrate loading

Edge pyrometer for enhanced temperature control of compound semiconductors and sapphire substrates processing with susceptor.

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DLI-CVD / ALD systems Technology advantages

- Reactors designed for R&D applications
- Low cost of ownership, low maintenance requirements
- Thermalized walls technology, deposition only on substrate
- No complicated shower heads
- Optimized integration of vaporizers
- Embedded Kemstream direct liquid injection vaporizers
- State of the art liquid panel for easy precursor management
- Reactor by-pass
- Multi process capability: CVD, ALD, pulse pressure CVD…

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MC-050

Laboratory 2-inch DLI-CVD system

Multi-process capability : DLI-CVD, DLI-ALD, MOCVD, RTP

Features:

- Lamp furnace for process up to 1100°C
- Thermocouple control with PID temperature controller
- Up to 6 precursors or precursor mixtures
- Downstream pressure control
- Purge gas line with needle valve
- Up to 6 process gas lines with digital MFC
- PC control with Ethernet communication
- Optional glove box

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MC-100

4-inch CVD reactor for R&D

Metals & alloys, oxides, transition metal nitrides, carbon nanotubes, nanowires, etc…

Features:

- Stainless steel thermally controlled chamber
- Rotating and heating substrate holder up to 850°C
- Substrate holder with vertical motion
- Up to 4 precursors or precursor mixtures
- Vaporizer reactor by-pass
- Thermocouple control with PID controllers
- Vacuum and pressure control
- Purge gas line with needle valve
- Up to 6 process gas lines with digital MFC
- PC control with Ethernet communication

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MC-200

200 mm CVD reactor for R&D

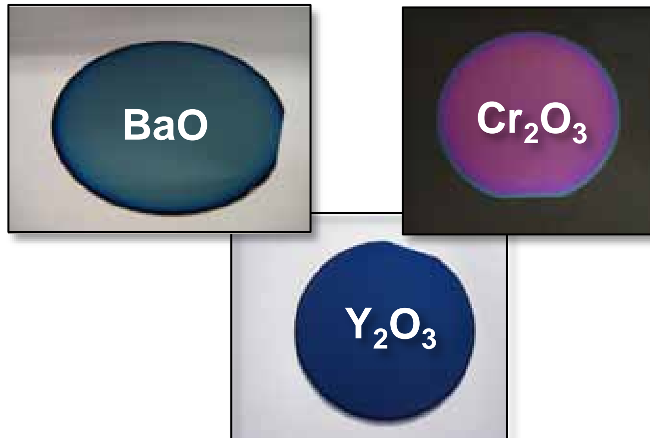
Metals & alloys, oxides, transition metal nitrides, carbon nanotubes, nanowires, etc…

Features:

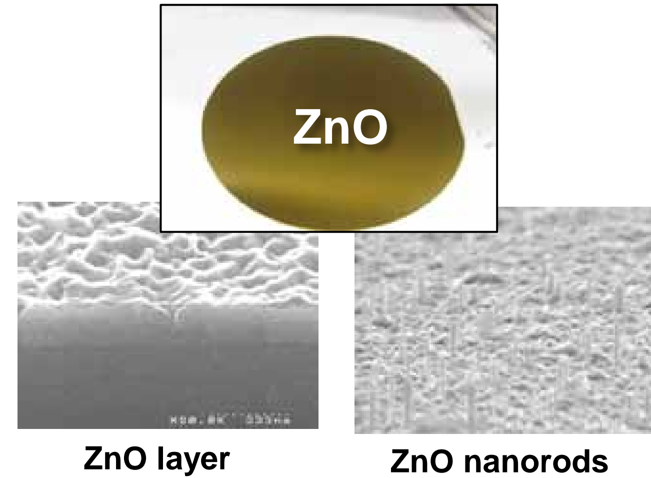
- Stainless steel thermally controlled chamber
- Rotating and heating substrate holder up to 850°C
- Optional capacitive plasma
- Substrate holder with vertical motion
- Up to 4 precursors or precursor mixtures
- Vaporizer reactor by-pass
- Thermocouple control with PID controllers
- Vacuum and pressure control
- Up to 8 process gas lines with digital MFC
- PC control with Ethernet communication
- Optional motorized loadlock

DLI-CVD Processes

Oxide layers on 4-inch silicon wafers

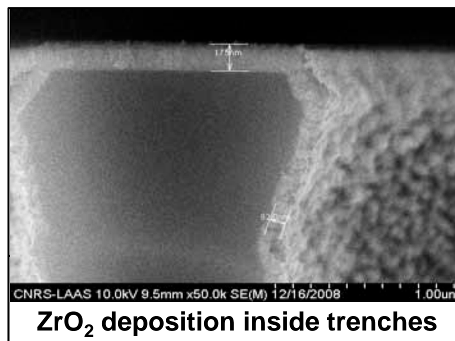


ZnO deposition on 4-inch silicon wafer

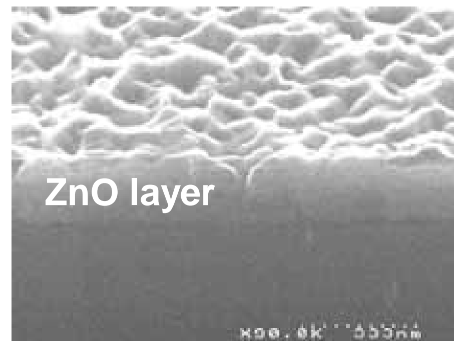


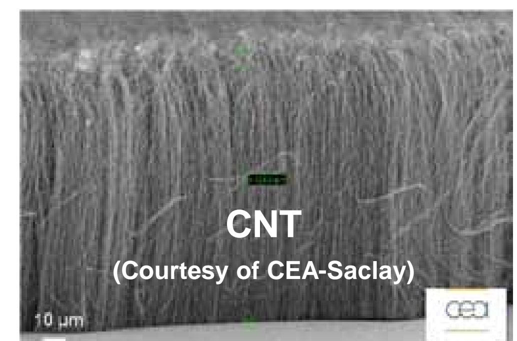
ZnO layer

ZnO nanorods



ZrO_2 deposition inside trenches





SprayCVD-050

Laboratory 2-inch system for new process development Spray CVD & RTP in the same reactor

Features:

- Lamp furnace for process up to 1200°C
- Thermocouple control with PID temperature controller
- Kemstream Atokit for atomization of precursor
- Purge gas line with needle valve
- PC control with Ethernet communication

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LC-100 / LC-102

4-inch LPCVD furnace
Poly silicon, SiO_2, Silicon Nitride

Features:

- Tubular 3-zone furnace
- Digital PID temperature controllers
- Atmospheric and vacuum process capability
- Up to 50 wafers per batch
- Purge gas line, up to 8 process gas lines with digital MFC
- PC control with Ethernet communication
- Optional turbo pump
- Single and double tube (LC102) versions

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Control software

- Windows 7 compatible
- Same software for all systems
- Ethernet communication with furnace
- 3 access levels
- Diagnostic capabilities
- Traceability option
- Automatic upgrade procedure

Thank you for your attention

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