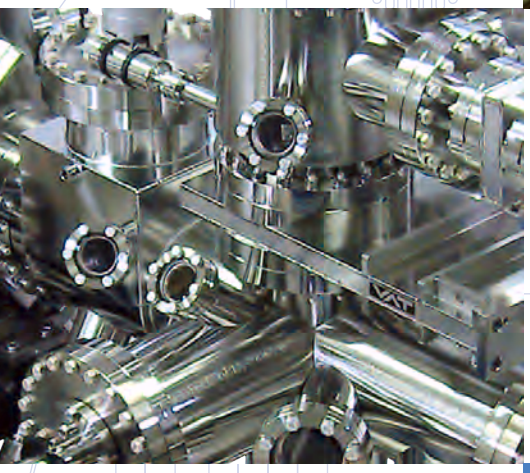
SVT Associates, Inc.

Product Catalog



A Leader in the Innovation, Design and Production of MBE Technology

SVT Associates, Inc.

Engines for Thin Film Innovation

SVT Associates, Inc.

Engines for Thin Film Innovation

SVT Associates

SVT Associates offers a full range of MBE, thin-film deposition, in-situ process monitoring, and related UHV equipment for advanced materials.

Since 1993, we have designed and delivered tailored solutions for emerging materials through MBE, ALD, PVD, PLD, and UHV deposition equipment innovations. In addition, SVT Associates has developed new sources and techniques for CIGS research and development in the rapidly advancing field of photovoltaics (PV).

MBE is a key technology in advanced Semiconductor research and development due to the unique structures and exact dimensional control that can be achieved. Semiconductors continue to be a driving force in productivity and capability advances in the world around us. The progress in computers, communications, and medical electronics are due to advances in semiconductors. Today semiconductor technology is at the heart of game changing green technologies for lighting, solar power generation, and electric power control and management. SVT Associates is continuously developing strong combinations of equipment, manufacturing, and process know-how, which has provided researchers with the tools needed to create advanced devices leading to breakthrough solutions.

Advanced Materials Research Laboratory

SVT Associates' Advanced Materials Research Laboratory offers thin film epitaxial and process development services, as well as contract research. Our lab scientists are experts in epitaxial growth of semiconductor and optoelectronic materials. We have expertise in the deposition of oxides – for example oxide MBE including Plasma Enhanced MBE and Laser MBE. Our Lab has cutting edge publications in nitride MBE including the development of unique high power HEMT structures and UV detectors. Our work with MBE of antimonides includes InAs/InGaSb Superlattices for Infrared Detection and Imaging.

The process knowledge gained from our on-site Advanced Materials Research Laboratory is incorporated in the design of our equipment for superior performance, longevity, and value. SVT Associates is continuously developing strong combinations of equipment, manufacturing, and process know-how to provide the best support for your thin film deposition application.

SVT MBE

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SVT Associates, Inc.

Engines for Thin Film Innovation

Customer Service

SVT Associates provides extensive training and continuing customer service support to ensure fast start up and smooth operation at the customer's facility. SVT Associates products are warranted against defects in material and workmanship. Service contracts are also available.

SMART MBE/Pulsed Laser Deposition/PVD

SVT Associates offers a variety of versatile, cost effective thin film deposition tools, backed by in-house experts.

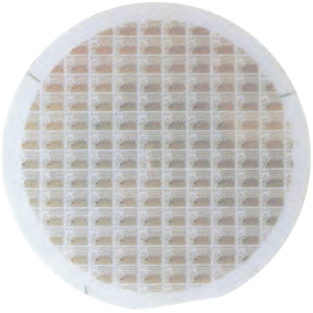
NanoFab MBE Model NFMBE-100, MBE System with Load-Locked Effusion Cells

NorthStar Atomic Layer Deposition (ALD) Systems

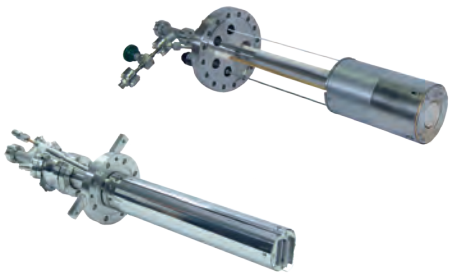
Ammonia Gas Injectors

Valved Crackers

Effusion Cells



Epi-Wafer Service Available



RF Plasma Sources for Nitride Growth

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Table of Contents

SVT Associates, Inc.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SVT Associates, Inc.

- Leading manufacturer of thin film deposition equipment with over 120 systems in the field.
- In-house Applications Laboratory with seven deposition systems producing world class materials.
- Continuously developing strong combinations of equipment manufacturing and process know-how.
- Diverse system product line spanning the thin film deposition market.

SVT Associates Manufacturing and Research Facility in Eden Prairie, MN

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

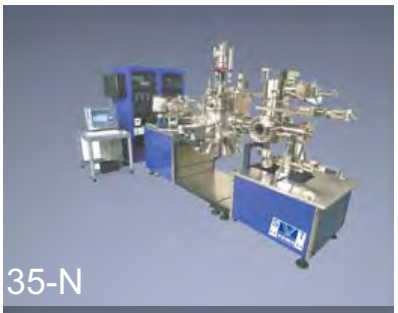
MBE Systems

Engines for Thin Film Innovation

Molecular Beam Epitaxy (MBE) is a key enabling research and manufacture technology for semiconductor materials and devices. The MBE systems provide an ultra-pure environment for precision fabrication of a wide variety of thin film structures for microelectronic, optoelectronic and magnetic applications. Due to ever increasing demand of communication bandwidth and chip density, device fabrication relies on exacting dimensional and quality controls that MBE provides.

Model S-8

Model	Applications	Wafer Size
35-4	III-V, II-VI or Other Compound Semiconductors	4"
35-N	Nitride Semiconductors	4" or 3 x 2"
35-6	III-V, II-VI or Other Compound Semiconductors	4", 6", or Multiple 2"
35-G-4	III-V Compounds, SiGe	4"
SM-6	Si, Ge, Metals	4" or 6"
S-8	Si, Ge, Dielectrics	Up to 8" with Cluster Tool
UVD-02	Oxides and other Dielectrics	4" with Liquid Injector
PLD-02	Oxides, Multi-element Compounds	4" Laser/E-Beam Deposition



35-N

SM-6

35-6

UVD-02

PLD-02

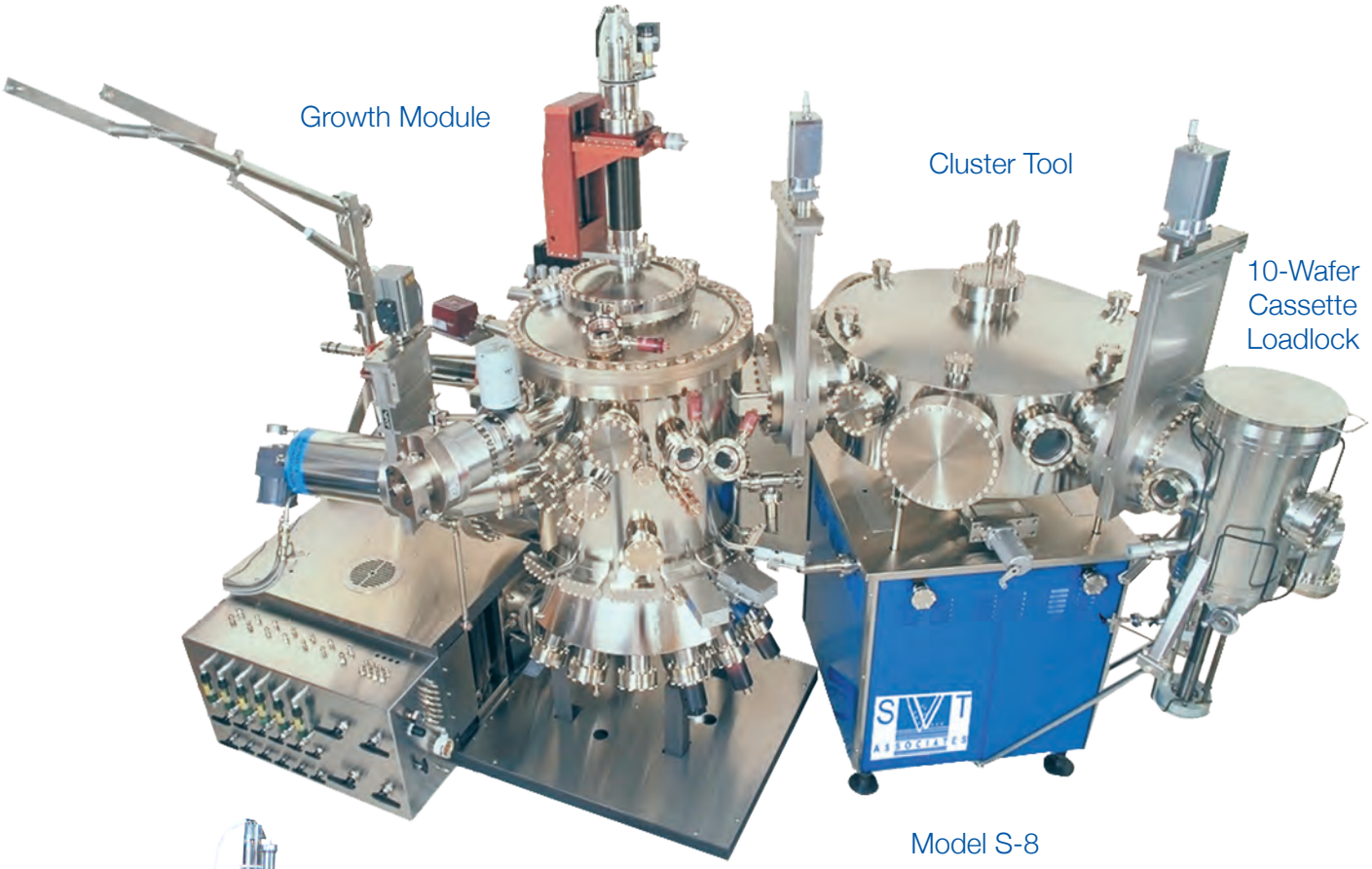
SVT MBE

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

MBE Systems SM-6 and S-8 with Cluster Tool

Engines for Thin Film Innovation

SVT Associates' MBE Systems are designed around a modular concept, typically including sample introduction load-lock, preparation/analysis, and main reactor growth modules. Each module has its own independent ultrahigh vacuum (UHV) pumping and each chamber can be isolated from the others by gate valves.



Model S-8

Model SM-6 SiGe System

The SiGe system is intended to satisfy the demands of high quality growth of Silicon/Germanium and related compounds. It combines electron beam and effusion cell evaporation sources for deposition, and uses sensor feedback control to achieve highly reproducible thin film fabrication.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

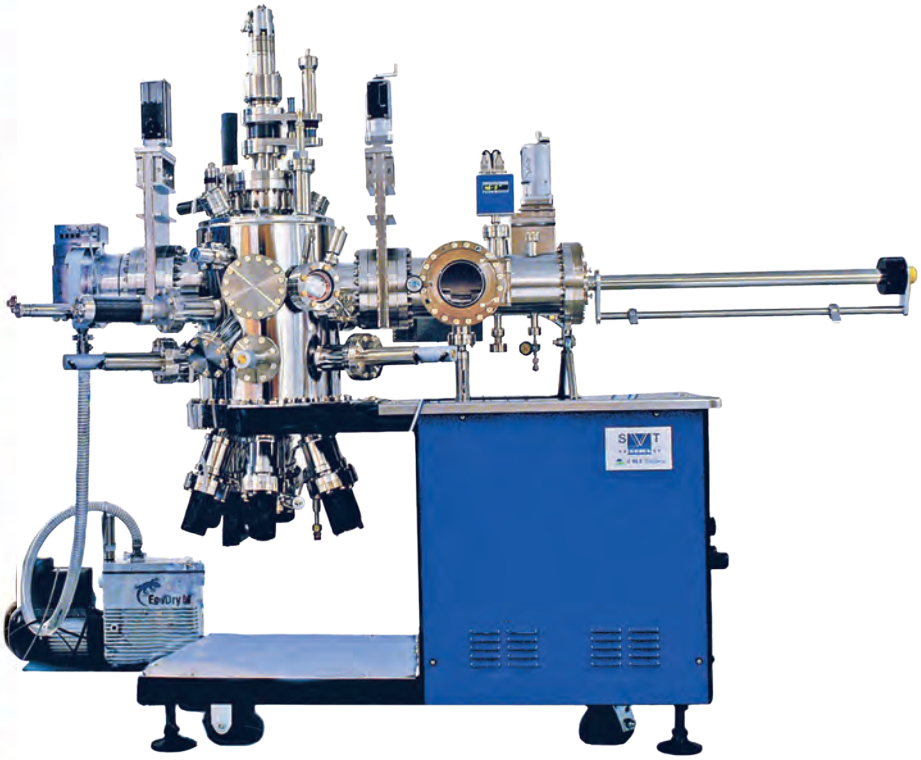
Compact MBE System Model SVT-V-2

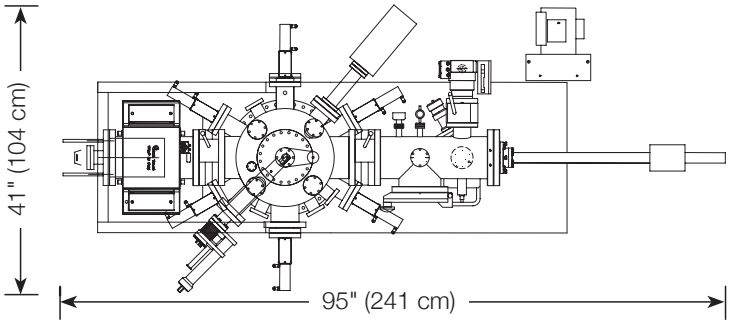
Engines for Thin Film Innovation

Description

Efficient use of MBE technique for materials research including compound semiconductors, nitrides, oxides, and ferromagnetics.

Model SVT-V-2, -3





Features

- Small Footprint
- Up to 8 Sources
- Sample Temperature up to 1,000 °C
- Fast Action Shutters
- Master Wafer Shutter
- Flexible Configuration, including Preparation Chamber and Cluster Tool

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

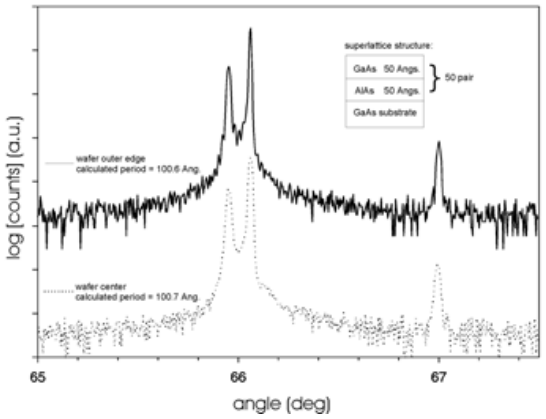
MBE Systems Models 35-6 & 35-N-V

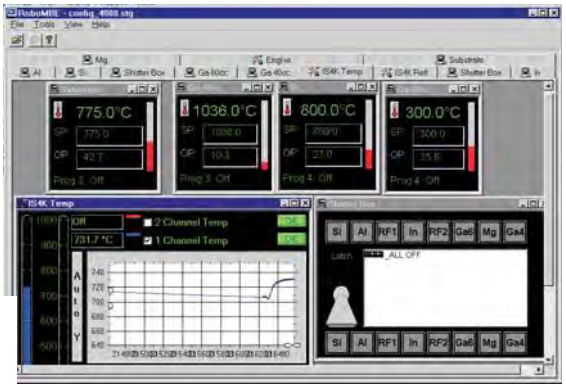
Engines for Thin Film Innovation

Model 35-6

AlGaAs (or other Semiconductors) Research and Production Machine for Wafer size up to 6"

X-Ray Analysis of Layer Uniformity for 4" Wafer





RF-Plasma Source and Matching Network

Multiple Inlet Gas Injector

Model 35-N-V

Standard 4" substrate MBE platform for high quality semiconductor nitrides. Designed to handle the harsh active nitrogen environment and is equipped with a very high temperature substrate heater. The nitrogen species can be generated by either RF-Plasma or Ammonia Source.

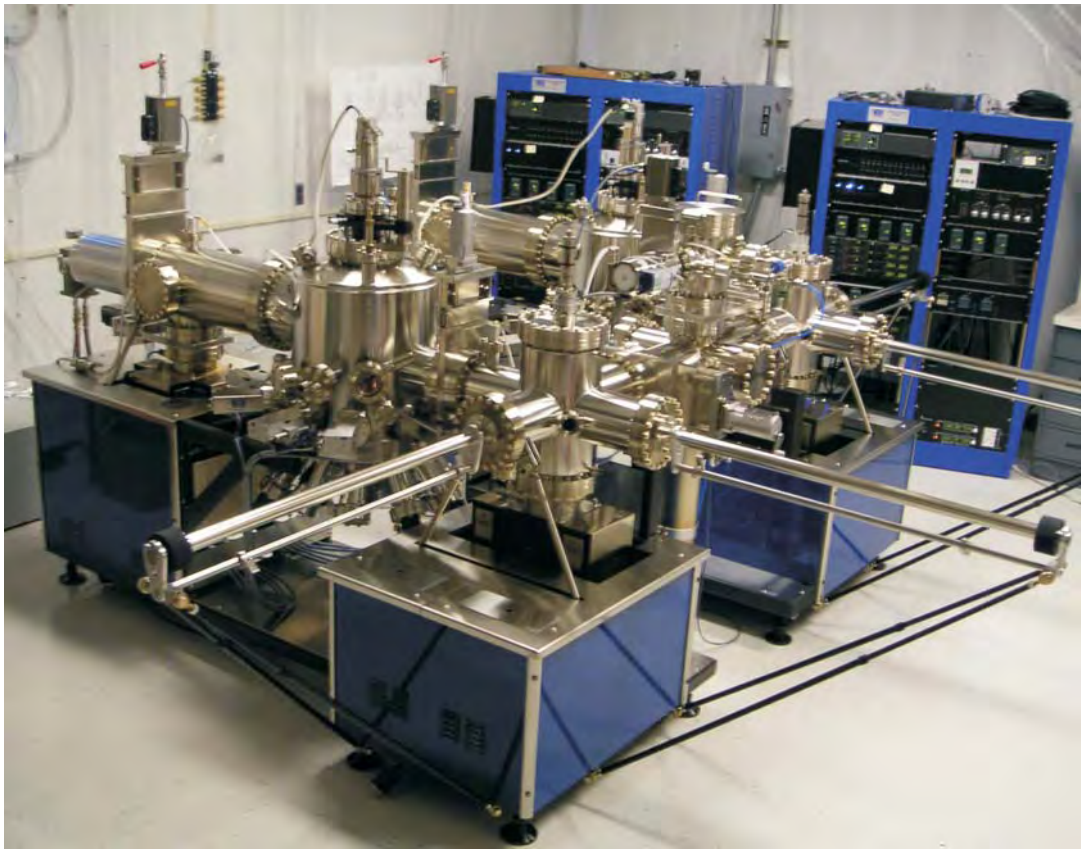
SVT MBE

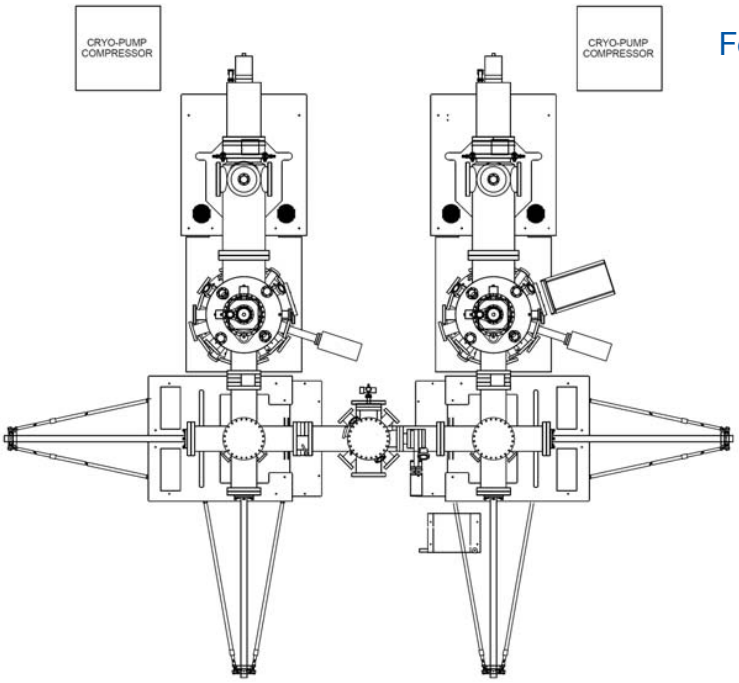
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Dual MBE System

Engines for Thin Film Innovation

Model 35-D4





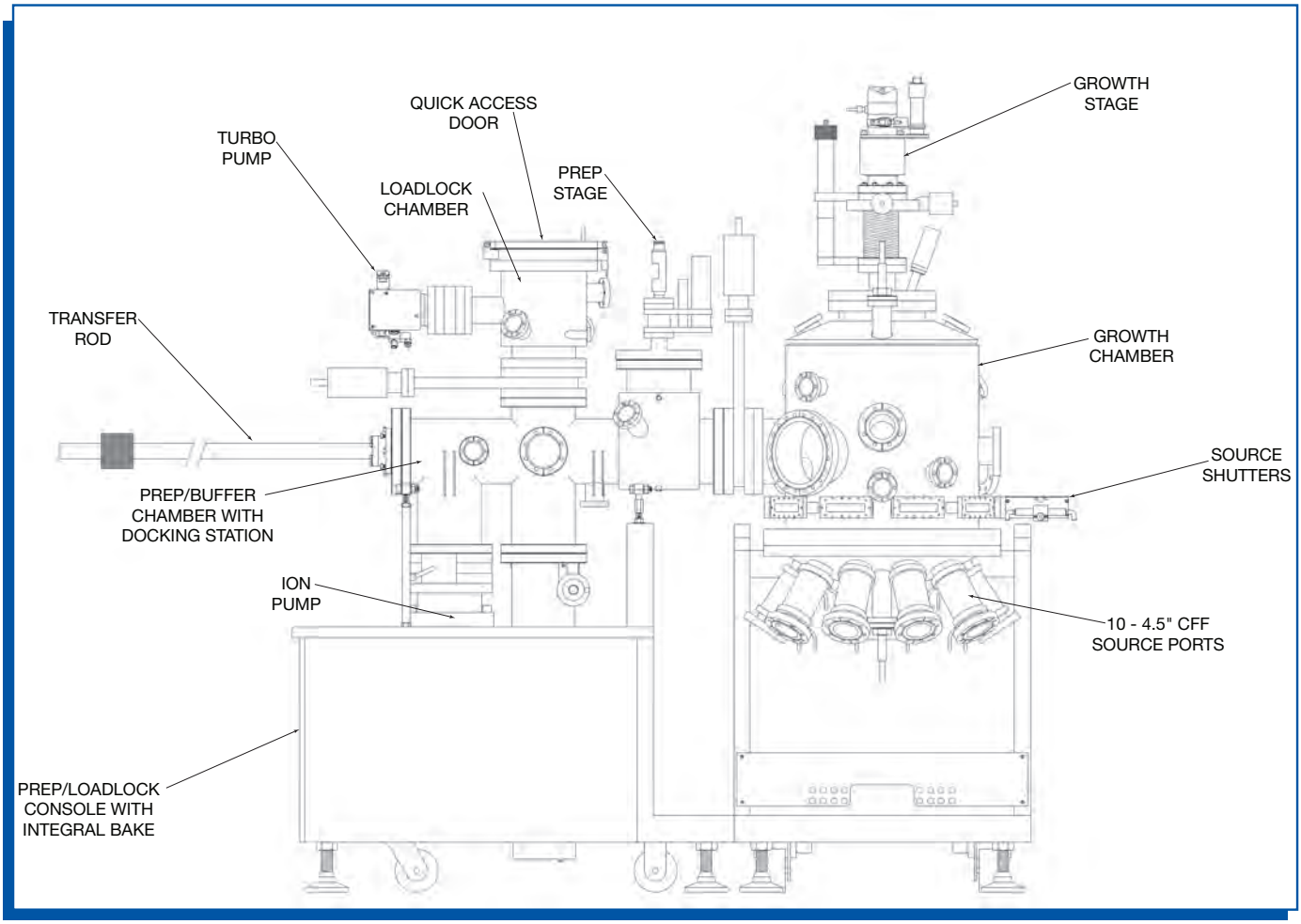
Features

- Wafer transport under UHV condition to minimize contamination
- Up to 12 Sources for each growth module
- Each module can handle up to 3" x 4" wafers
- Multiple configuration possible for future expansion
- Can be integrated to other processing tools

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Nitride MBE System

Engines for Thin Film Innovation



Schematic drawing of a 3-zone Nitride MBE system with load lock, buffer and growth chambers. Ten source ports are provided, each with a linear motion shutter. The substrate heater provides full rotation at the high temperatures required for Nitride growth.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Facility Layout Requirements

Engines for Thin Film Innovation

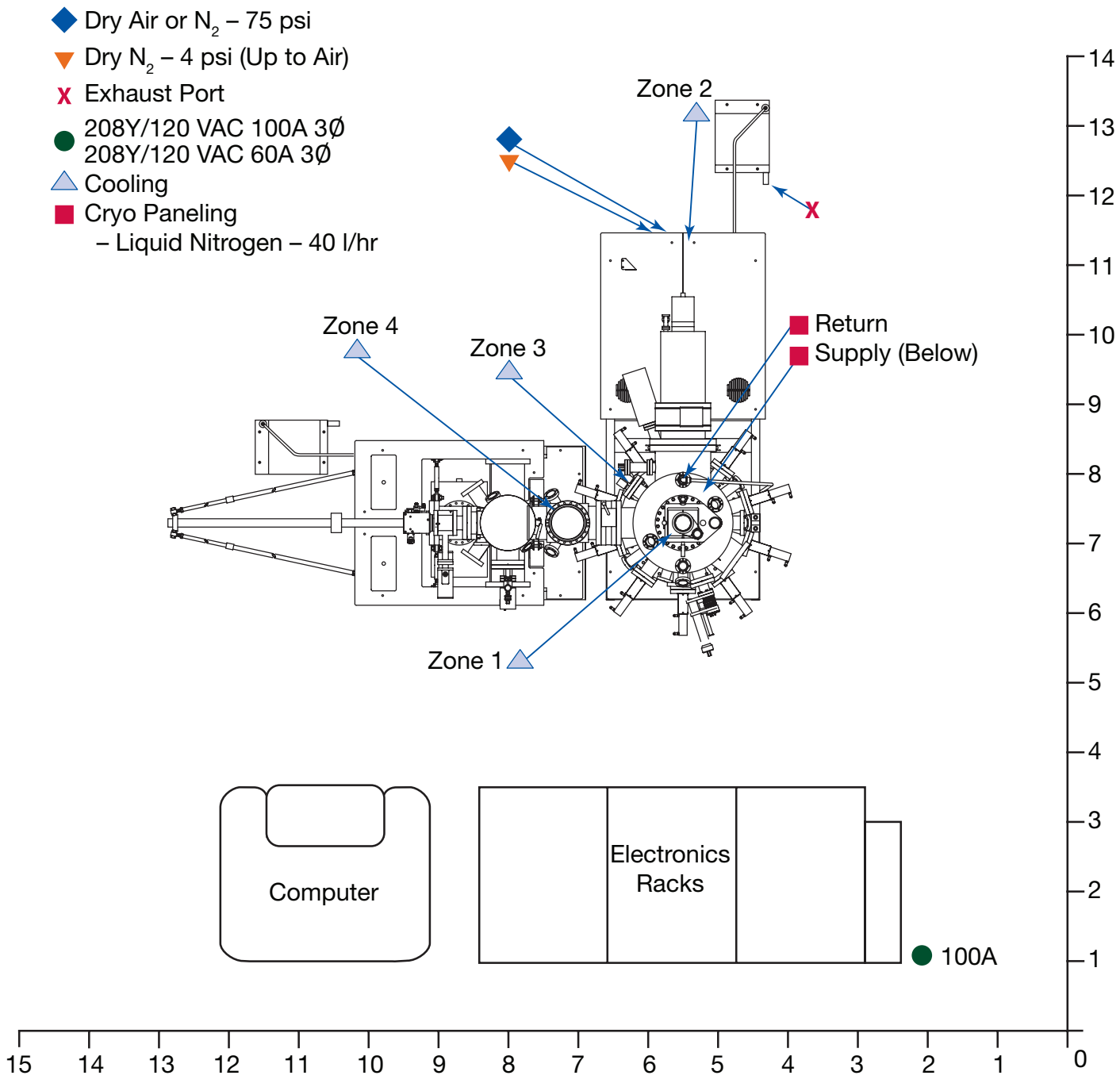


Figure 1

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Facility Requirements

208Y/120 VAC 125A 3Ø

The power requirement for the system is 125A-3Ø at 208V. The power is connected through the power distribution enclosure that is located on the side of the electronics racks. A 4 m 'pigtail' will be provided for the hook-up between the lab service disconnect box and the power distribution enclosure, as shown by the dot in Figure 1. This pigtail is a 1½" flexible metallic conduit, that contains five wires: Three Hot, One Neutral, and One Ground.

Cooling Water

The locations for the cooling water connections for the system are shown in Figure 1. Each location requires an inlet and an outlet. The fitting sizes are listed with the individual connections:

- Zone #1 – Growth Manipulator Cooling – .5 l/min – ¼" Swagelok
- Zone #2 – Growth Module Turbo Cooling – .5 l/min – ¼" Swagelok
- Zone #3 – Source Tube Cooling – 1 l/min – ⅜" Swagelok
- Zone #4 – Prep Chamber Cooling – 2 l/min – ¼" Swagelok
- Zone #5 – Gas Cabinet Turbo Cooling – .5 l/min – ¼" Swagelok

Dry Air or N_2 – 75 psi (for Gate Valves)

Dry Air or Nitrogen is required to operate the pneumatic gate valves. The minimum required pressure is 75 psi . A ¼" Swagelok connection will be provided for the attachment. Location of the Swagelok fitting is shown in Figure 1. Maximum flow rate of 8 m^3/hr when gate valves are being actuated, with a typical volume of ~120 cc per valve actuation. Typical flow rate when operating system ~0^{3}m/hr.

Dry N_2 – 4 psi (Up to Air)

Dry Nitrogen is required to vent the individual modules of the system. The input for the dry nitrogen is shown in Figure 1. It is a 6 mm Swagelok fitting. Maximum flow rate of 0.5 m3/hr at .3 bars when system is being vented. Typical flow rate when operating system ~0 m3/hr.

LN_2 – 40 l/hr

Liquid Nitrogen is required to be used in the cryo panels. The fittings for the supply (bottom) and return (top) are 15 mm tubes. 15 mm Swagelok unions will be provided for connection. An LN_2 line will be provided to connect the lower and upper cryo panels. Typical flow rate when operating system 30 l/hr.

Exhaust Port

The Exhaust Ports for the roughing pumps are located on the top of the rough pumps. Depending on the nature of the gases that will be used, this exhaust system may need to be corrosion resistant.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

General System Information

The footprint for the system itself is about 7' x 7' (2.2 m x 2.2 m). However, the minimum required floor space for the system is about 14' x 15' (4.3 m x 4.6 m). This would include space for the electronics racks and also adequate room for operation of the system. The overall height of the assembled system is about 6' (1.83 m). However, an extra 3' (1 m) is required to remove the manipulator from the growth chamber. The approximate weights of the two modules and electronics racks are:

Growth Module: 1,300 lbs (590 kg)

Prep/Load Lock Module: 800 lbs (363 kg)

Electronics Racks: 1,000 lbs (454 kg)

The shipping size of the system varies from module to module. The largest module will be about 7' (2.2 m) long and 4' (1.22 m) wide. The shipping height of the largest module will be about 6' (1.83 m).

SVT Associates will provide the necessary tools for installation. Tools that are necessary for the operation of the system will need to be supplied by the customer. Standard tools for the system would include, but not be limited to:

Combination Wrench Set – Standard (Up to $^{15}/_{16}$")

Combination Wrench Set – Metric (Up to 17 mm)

Additional wrenches of: 10 mm, 13 mm, 17 mm, $^{1}/_{2}$", and $^{9}/_{16}$"

Hex Key Wrench Set – Standard

Hex Key Wrench Set – Metric

Screwdriver Set – Slotted and Phillips

Precision Screwdriver Set

Precision Pliers Set

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Pulsed Laser MBE System

Engines for Thin Film Innovation

Description

Laser Molecular Beam Epitaxy (MBE) leverages unique features of both Pulsed Laser Deposition (PLD) and conventional MBE for depositing complex thin films with atomic layer precision and control. By adding laser ablation capability to MBE, high purity materials can now include high melting point ceramics and multi-component solids. Using its 15 year history in MBE equipment technology, SVT Associates has further advanced the technology by adding in-situ monitoring capabilities related to temperature, thickness, RHEED, and Atomic Flux monitoring while providing a full complement of source technology for unprecedented material capabilities. Please contact SVT Associates for more details.

Applications

Oxide semiconductors, high-Tc superconductors, optical crystals, electro-optical films, ferroelectric and ferromagnetic materials.

UHV Target and Sample Shown within MBE Growth Chamber

Standard Features

- True UHV (< 1 x 10^{-10} Torr Base Pressure)
- Multiple Deposition Source Technologies
  - RF Plasma
  - Effusion Cells
  - E-Beam Evaporation
  - Ozone Delivery System
- Advanced In-Situ Monitoring Options
  - Atomic Absorption Flux Monitor
  - RHEED
  - Temperature & Thickness Monitor
- Six Rotatable PLD Targets
- High Power Excimer Laser
- Tailored Pumping Combinations
- Versatile Chamber Configurations
- Training and Service Support

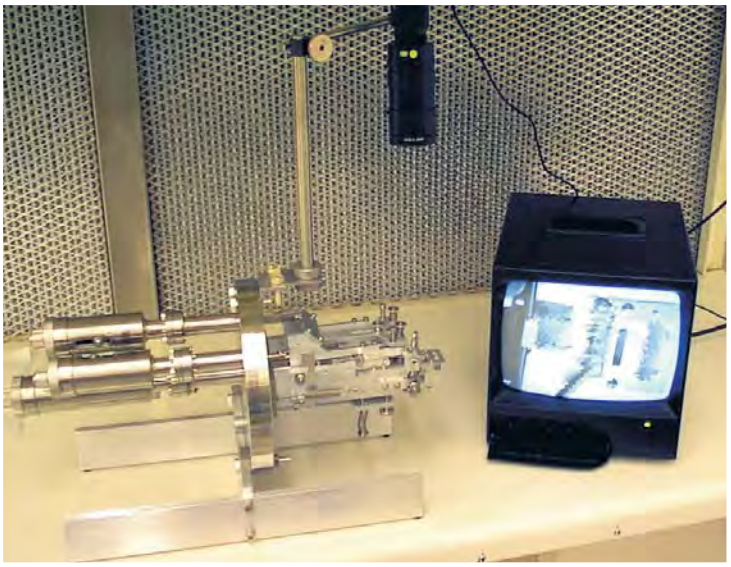
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

UHV Wafer Cleaving Apparatus

Engines for Thin Film Innovation

Description

SVT Associates' Wafer Cleaving Apparatus cleaves 15 mm square wafers into 15 mm long by 1 mm wide bars. The bars are collected in a transfer/ deposition block for batch processing. The block design allows both edges of the multiple bars to be coated. All parts of this apparatus are designed for minimal device damage and sticking. The cleaving apparatus is fully UHV compatible with metal seals and bellows sealed feedthroughs.



Model WC 15-1

Specifications

- In-Situ bar Cleaving
- 15 mm x 15 mm Substrate Input
  (Other sizes available)
- 15 mm x 1 mm Substrate Output
  (Other widths available)
- 8" CFF Mounting
- Bakeable to 180 °C
- Substrate docking from two directions
- Fully UHV Compatible
- Single Flange Mounting
  (All Adjustments Made on Bench)
- Cassette Loading

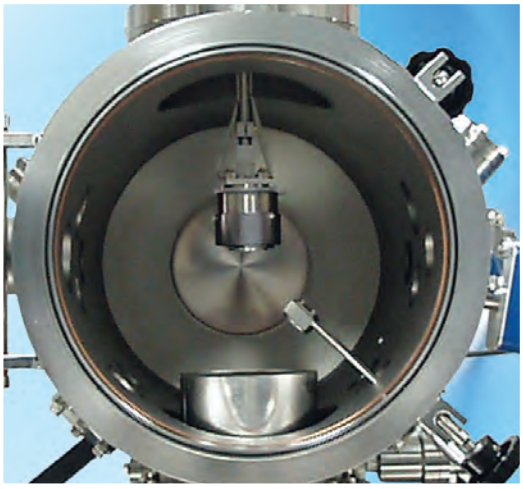
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SMART NanoTool PLD
Versatile Research Pulsed Laser Deposition

Engines for Thin Film Innovation

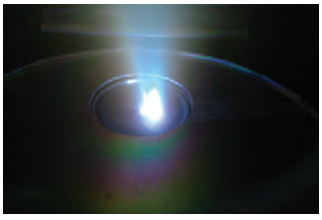
SMART NanoTool PLD

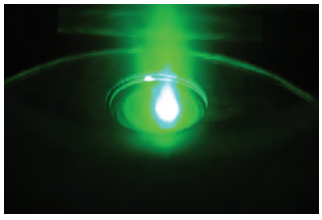
- SVT Associates' SMART (Scientific Materials and Applied Research Tool) Pulsed Laser Deposition System is a unique research tool, combining Laser Ablation with our unique deposition techniques offers a broad range of possible materials and applications.
- A multitude of thin film structures are possible utilizing six rotational targets that are individually indexed.
- Interfaces with Excimer and Yag Lasers.
- Optional in-situ monitoring tools provides the user with enhanced process feedback.
- Available load lock sample handling allows the SMART system to interface with other deposition or metrology tools.

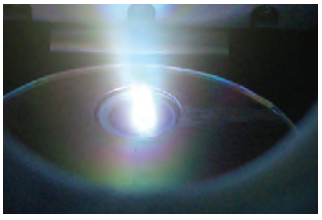


Applications

- Multiple Component Complex Oxides
- High Temperature Superconductors
- Magnetic and Metallic Material Deposition
- Low Vapor Pressure Materials
- MEMS







SVT SMART

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SMART NanoTool PLD-01

Engines for Thin Film Innovation

BASE SYSTEM

Chamber and Vacuum Pumps

12" Quick Access Door, 250l/s Turbo Pump
Full Range Vacuum Gauges

Deposition Sources

Target Stage, Six 1" (25 mm) Targets with Rotation and z-Direction Translation

Deposition Stage

1" (25 mm) Sample Size, Heating to 800 °C, Continuous Rotation, z-Direction Translation

In-Situ Process Monitoring Tools

Quartz Crystal Deposition Rate Monitor

AUTOMATION

Automation Package:

Control Sample Temperature and Rotation
Indexed Target Position
Target Rotation
Gas Control
Compute Rate & Thickness using QCM Output
Laser Beam Scanning *(optional)*
Laser Interface for Beam Blanking
Automated Pumpdown and Venting
Differential Pumping
RHEED Analysis *(optional)*
Load Lock Pressure Monitoring *(optional)*

AVAILABLE OPTIONS:

Deposition Sources

Thermal Evaporation Sources, Effusion Cells, Sputter Sources, E-Beam Evaporators, RF Plasma Sources

Deposition Stages

Multiple Options Up to 2" (51 mm) Sample Size

Metrology Tools

10kV to 30kV RHEED Packages

Vacuum Packages

Ion Pumps, Turbo Pumps, Cryo Pumps, Gate Valves

Gauge Packages

Multiple Gauge Packages Available

Gas Control Packages

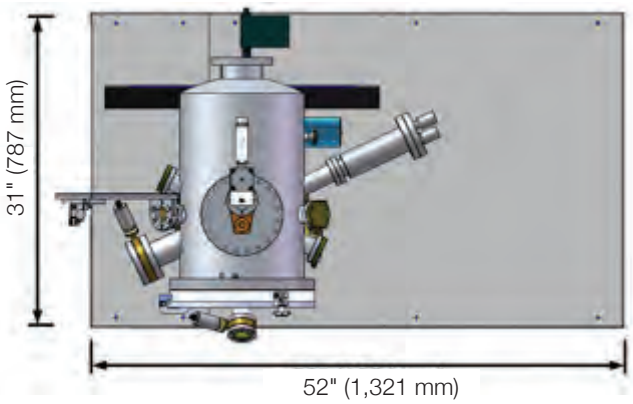
Mass Flow and Leak Valve Packages
Upstream and Downstream Throttling Control

Loadlock Package

Loadlock, Docking and Transfer Configurations

Ultra High Vacuum

Differential Pumping and System Bakeout Options Available



7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SMART Evaporation PVD
Versatile Research Physical Vapor Deposition

Engines for Thin Film Innovation

SMART Evaporation PVD

- SVT Associates' SMART (Scientific Materials and Applied Research Tool) Physical Vapor Deposition System is a unique research tool. Combining multiple deposition techniques in a single chamber allows researcher to continually develop complex materials for the future as well as simple processing techniques.
- The compact footprint preserves laboratory space.
- Optional in-situ monitoring tools provides the user with enhanced process feedback.
- Available load lock sample handling allow the SMART system to interface with other deposition or metrology tools.

Applications

- Multiple Technique Thin Film Deposition
- Ohmic Contact Deposition and Annealing
- Ion Beam Process (Etch and Deposition)
- Semiconductor Mask Preparation
- Metallization

SMART

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SMART NanoTool PVD-Thermal and E-Beam Deposition Tool
SMART NanoTool T-01 and SMART NanoTool E-01:

Engines for Thin Film Innovation

BASE SYSTEM

Chamber and Vacuum Pumps

12" Quick Access Door, 250l/s Turbo Pump

Deposition Sources

SMART NanoTool T-01

Three Thermal Evaporation Boats with Shutters

SMART NanoTool E-01

Water Cooled 4-Pocket Electron Beam Evaporator

Deposition Stage

SMART NanoTool T-01

1" (25 mm) Sample Size, Continuous Rotation

SMART NanoTool E-01

1" (25 mm) Sample Size, Heating to 800 °C, Continuous Rotation, z-Direction Translation

In-Situ Process Monitoring Tools

Quartz Crystal Deposition Rate Monitor

Gauges

Full Range Gauges

ADDITIONAL OPTIONS

Deposition Sources

Thermal Evaporation Sources, Effusion Cells, Sputter Sources, E-Beam Evaporators

Deposition Stages

Multiple Options Up to 3" (76 mm) Sample Size

Metrology Tools

RHEED Packages

Vacuum Packages

Ion Pumps, Turbo Pumps, Cryo Pumps, Gate Valves

Gauge Packages

Multiple Gauge Packages Available

Gas Control Packages

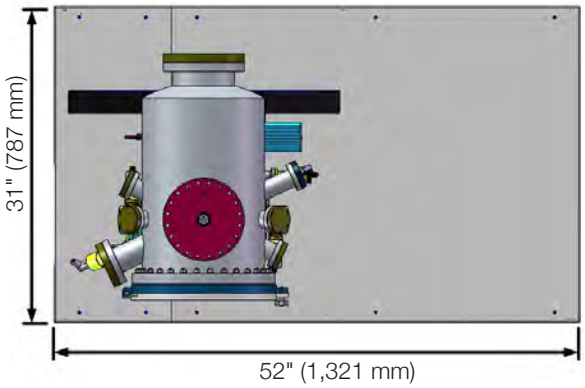
Mass Flow and Leak Valve Packages

Loadlock Package

Loadlock, Docking and Transfer Configurations

AUTOMATION

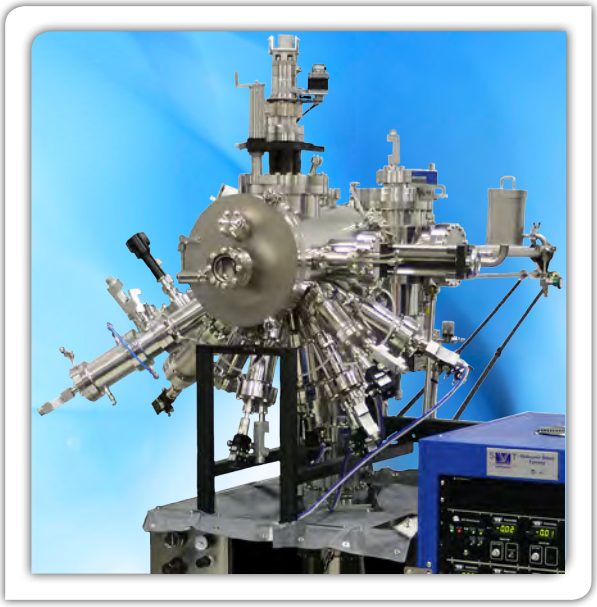
Advanced Automation Packages Available



7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SMART NanoFab MBE
Versatile Compact Research System

Engines for Thin Film Innovation



SMART NanoFab MBE

- SVT Associates' SMART NanoFab MBE system is the perfect combination of small footprint and large capability. The table-top UHV chamber includes a series of ports to accommodate a wide selection of deposition sources and process monitoring tools.
- A multiple sample load-lock allows for rapid sample loading while maintaining the high purity environment.
- The integrated electronics racks and convection bake system provides convenient control of the entire system.
- Complete process automation is available through the RoboMBE™ software suite.

Applications

- III-V, II-VI, II-Oxides, III-Nitrides and other materials
- Multi-Technique Deposition MBE

SVT Associates, Inc.

- Leading manufacturer of thin film deposition equipment with over 120 systems in the field.
- In-house Applications Laboratory with seven deposition systems producing world class materials.
- Continuously developing strong combinations of equipment manufacturing and process know-how.
- Diverse system product line spanning the thin film deposition market.

Deposition Sources and Monitoring Tools

- Effusion Cells
- RF-Plasma Source
- Gas Injection
- RHEED and RHEED Image Analysis Software
- AccuFlux In-Situ Process Monitor
- Quartz Crystal Monitor
- Linear Flux Monitor for Calibration

Effusion Cells

RF Plasma Sources

Valved Crackers

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SMART NanoFab MBE – Specifications

Engines for Thin Film Innovation

BASE SYSTEM

Chamber and Vacuum Pumps

12" Access Flange

1,500l/s Cryo Pump
Additional pumps available as options

Integrated Cryo-Shroud

Base Pressure: < $2x10^{-10}$ Torr

Deposition Sources

Eight Positions to Use:

16 cc Effusion Cells
Valve Cracking Sources

RF Plasma Source
Pneumatic Shutters

Deposition Stage

Up to 2" (50 mm) Sample Size

Heating to 850 °C *(1000 ºC w/water cooling)*

Continuous Rotation

z-Axis Translation

Master Shutter

In-Situ Process Monitoring Tools

Quartz Crystal Deposition Rate Monitor

Linear Flux Monitor

AccuFlux Process Monitor

AccuTemp Process Monitor

RHEED

Gauges

Full Range MicroIon Gauges

UHV Ion Gauges

Automation Package:

Pressure Readout

Auto Pump Down and Venting

Stage Heating and Rotation

Growth Recipe Control

Safety Interlocks

Load Lock

Quick Access Door

80l/s Turbo Pump

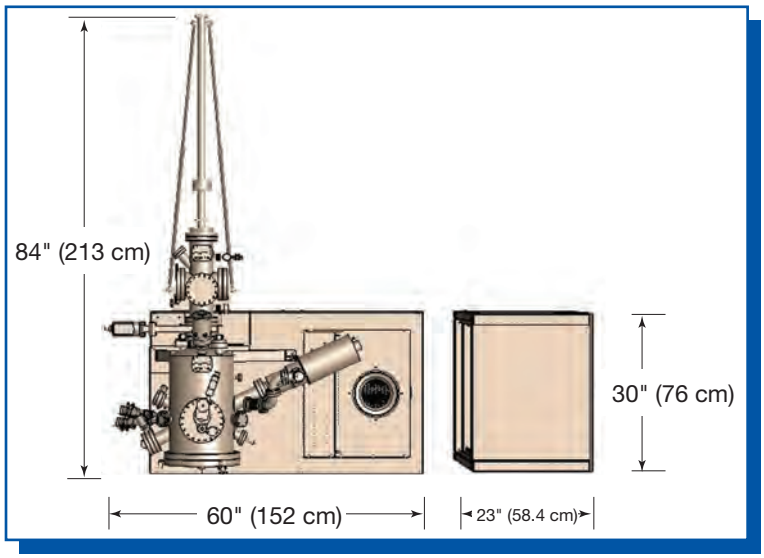
Six Position Sample Cassettes

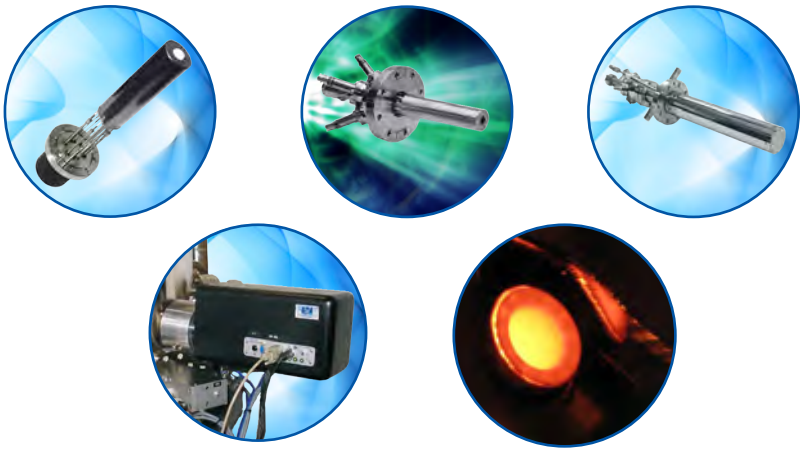
Magnetically Coupled Transfer Arm

Additional Features

Integrated Electronics Rack

Integrated Bakeout





7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

NorthStar™ ALD

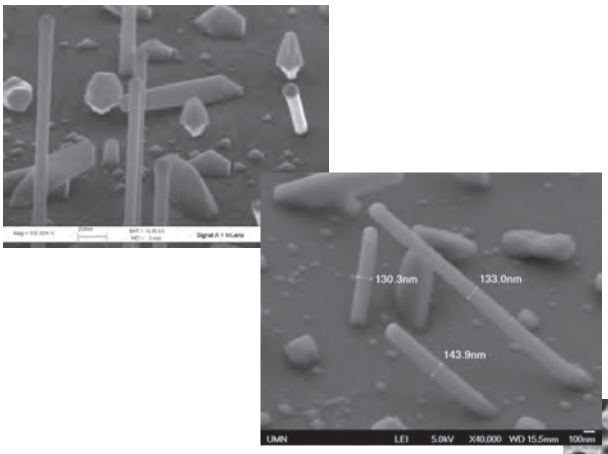
Engines for Thin Film Innovation

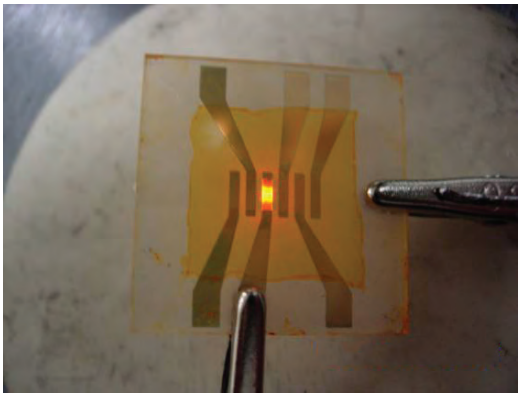
NorthStar ALD System

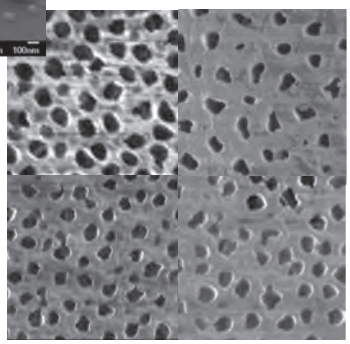
- The NorthStar Atomic Layer Deposition (ALD) system is a versatile research deposition tool for thermal or energy enhanced ALD.
- With up to 8 precursor lines and a hot wall deposition chamber, a wide range of applications may be performed by a single system.
- Sample introduction is rapid and convenient with a quick hatch or the optional load lock.
- The NorthStar ALD system can be interfaced with other deposition and metrology tools.
- Integration of in-situ metrology tools and the RoboALD™ software/system automation increases process reproducibility.
- Fully UHV upgradable.
- Demo and deposition services available.

Applications

- High-k Dielectrics
- Nanocoatings
- MEMS
- Photonic Crystals
- Diffusion Barriers
- Device Encapsulations
- Surface Modification Layers







7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

NorthStar™ ALD Model ALD-P-200B

Engines for Thin Film Innovation

Specifications Model ALD-P-200B

ALD REACTOR MODULE

Reactor Chamber
Up to 8" (200 mm) Wafer Capacity *(Optional 300 mm)*
Hot Wall Chamber Design – Temperature Controlled
(UHV Compatible version available)
Three Gas Inlet Injection Ports
(Two for Precursor Manifolds and One for Gas Inlet)
Close Coupled Sample Heater to 500 °C
Load Lock Flange, Pumping Port
Provision for Quartz Crystal Monitoring and RGA

Reactor Pumping
Dual Stage Rotary Vane Pump –
7 cfm (200 l/min)
Heated Pumping Line Isolated with Valve
(Optional Hot trap, Particle Filter, and Cold Trap in Pumping Line)
Other Pumping Options Available

Base Pressure
<1 x $l0^{-3}$ Torr or better

Vacuum Gauge
Convectron® Gauge

Electronics
Control Electronics
Sample Heater Power Supply and Controller
Chamber walls Heater Power Supply, Thermocouple and Temperature Controller
Gas Line Heater Power Supply, Thermocouple and Temperature Controller

ALD Console
Clean Room Compatible Metal Enclosure

PRECURSOR MANIFOLD(S)

Carrier Gas Line
One for Each Manifold (Typically N_2)
Mass Flow Control

Precursor Admission
Precursor sources from Liquid, Solid, or Gas phase
Heated Precursor Manifolds with up to 4 Precursors
Each *(Option for second Manifold for up to 8 Precursors)*
Fast ALD High Temp Valves (15 msec)
Metal VCR® fittings
Gas Line Heating to 200 °C

PROCESS CONTROL

Robo-ALD™
Software and Firmware – PLC
Based on NI LabVIEW® platform
Recipe Entry and Operation Loops
Logging of parameters – T, P, Flow, *(Optional RGA)*
Log files can be exported to Excel®
Automated pumpdown / vent to atmosphere

Deposition Uniformity
< ± 1 % over 200 mm – Reference – Al_2O_3, thickness > 20 nm

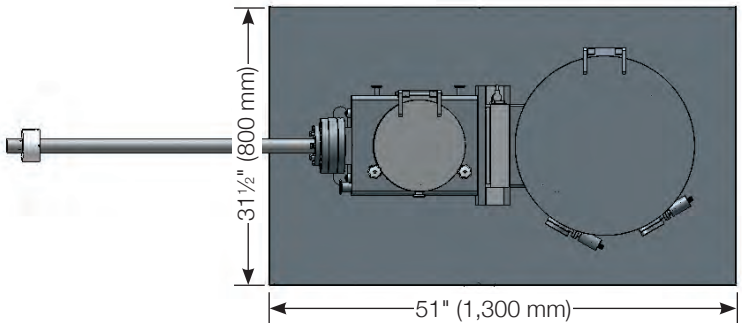
Deposition Mode
Standard, or "soak" mode for high aspect ratio samples

LOAD LOCK *(OPTIONAL)*

Load Lock Chamber
Sizes available up to 300 mm Wafer Capacity
Manual Gate Valve

Safety
Software safety interlocks
Smoke detector in cabinet
Low voltage Emergency Off (EMO)
Single point power connection

EXTERNAL SERVICES



Electrical Service
220/380 VAC, 50A, Single or Three Phase, 50-60 Hz

COMPRESSED AIR/N_2/Ar

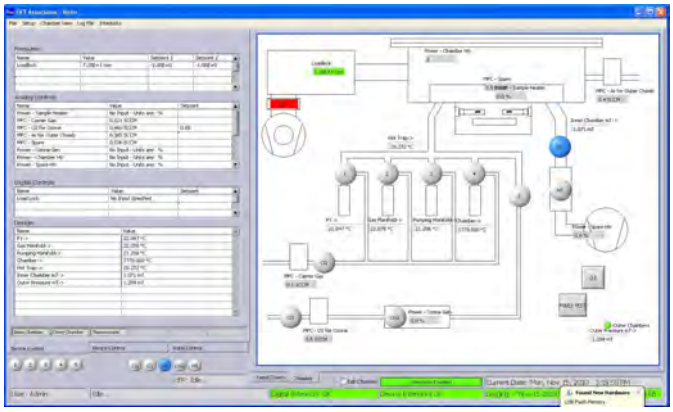
Valve Manifold
75 psi CDA at 0.1 cfm (500 kPa at 2.8 liter/min) pressure regulated
Relative humidity < 20% Dry N_2 may be substituted

Carrier Gas
5 psi (35 kPa) Research Grade N_2 or Ar
Also used to vent reactor

Exhaust
Vacuum pump and Cabinet

COOLING WATER

Reactor Chamber
2 l/minute at approx. 20 °C, or a water chiller when inner chamber wall is run >150 °C



7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

MBE Components

Engines for Thin Film Innovation

SVT Associates specializes in building custom or standard system components for your material research or thin film system. Our complete line of MBE components includes Sample Manipulator, Process Control Software, Source Flange, Deposition Components, and In-Situ Monitoring Instruments.

Source Flange

- UHV Compatible Precision Component Alignment
- Mounting Flange Size from 10" CF to 24" Wire Seal
- Center View Port for Pyrometry
- Large Liquid Nitrogen Feedthrough
- Integral Rotary Shutter Assemblies

Stages/Manipulators

- Optical Access to Wafer Backside
- Easy Alignment and Docking
- Water Cooled Rotational Bearings
- No Moving Wires for Greater Reliability
- Up to 8" wafers

RF Plasma Sources

- For N_2, O_2 and H_2
- Growth Rates up to 4 m/hr
- Optical Port for Plasma Monitoring
- 2.75", 4.50", or 6.00" Designs
- Custom Plasma Chamber and Apertures
- Automatic Tuning Matching Network
- Charge Suppression

Effusion Cells

- Sizes from 5 cc to 500 cc
- Hot Lip, Cold Lip, and Dual Filament
- Design Up to 1,400 °C
- High Temperature Cell to 2,000 °C

Ozone Gas Delivery System

- Fully Enclosed Gas Cabinet with Safety Monitor
- Highest Concentration of > 90%
- Precise Capacitance Based Flow Regulation
- For Ultra High Fluxes
- Abrupt Run/Vent Operation with Short Gas
- Lines to the Source Injector
- AccuFlux Process Monitor RoboMBE™ Computer Controlled Remote

AccuFlux Process Monitor

- Non-Intrusive, Multi-Flux Measurement of up to four materials
- Innovative Optical Design for Fluxes as low as 0.002 nm/s
- Precise Composition Control
- Full Computer Control with Industrial Interface to Shutter and Source Controller

In-Situ 4000 Process Monitor

- Reflectance Compensated Temperature Measurement
- Real-time Film Thickness Determination
- Film Index of Refraction Measurement
- Laser Light Scattering Measurement of Surface Microstructure

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Deposition Sources

Engines for Thin Film Innovation

MBE Deposition Source is one of the most critical components of any MBE system. They have a significant impact on composition, purity, and uniformity of the growing layers. SVT Associates has been recognized in the design and manufacture of high quality MBE sources. Our complete product line includes RF Plasma Sources, Effusion Cells, Electron Beam Evaporators, Crackers, and Gas Injector Sources. When choosing a MBE source, the most important criterion is the type of material to be evaporated. The table below is a general guideline of our recommendations for many common materials.

Material Selection Guide

IA																VIIIA
H	IIA											IIIA	IVA	VA	VIA	VIIA	HE
Li	Be											B	C	N	O	F	Ne
Na	Mg	IIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	AS	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub		Uuq		Uuh		Uuo

Lanthanides	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	
Actinides	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr	

RF Plasma Sources

Effusion Cells

Atomic Hydrogen

Valved Cracker

Gas Injector

Compact Electron Source

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

NH_3 MBE for Nitrides

Engines for Thin Film Innovation

High Throughput NH_3 Injectors

Specially designed injectors are used for delivering ammonia flux in today's advanced nitride research applications. Injectors may be connected to either a SVT Associates' high purity gas manifold or one supplied by the user. Models are available to connect up to three separate gas nozzles, each with an independent heater and thermocouple. Excellent nitride properties have been demonstrated using this injector, including very high GaN and HEMT mobility, and electron stimulated InGaN emission. Model #GI-RF1, shown on the left, is constructed for high throughput, with a RF heated corrosion resistant shower head plate for pre-cracking the ammonia. Its advanced features include:

- High pressure operation design
- Excellent uniformity with 3" or larger wafer with shower head aperture
- Stable temperature cracking up to 1,000 °C
- High throughput gas flow

Effusion Sources Specially Designed For NH_3 Environment

SVT Associates offers a wide range of effusion cells specifically designed for ammonia based nitride deposition. The Viking Effusion Cell utilizes a fully encased filament and a revolutionary shaped crucible for cell reliability and high performance deposition in an ammonia environment. Also offered is a Cold-Lip Effusion Cell for aluminum deposition. The proprietary source design creates a larger temperature gradient along the length of the source to reduce aluminum nitrideation on the source and improves material quality.

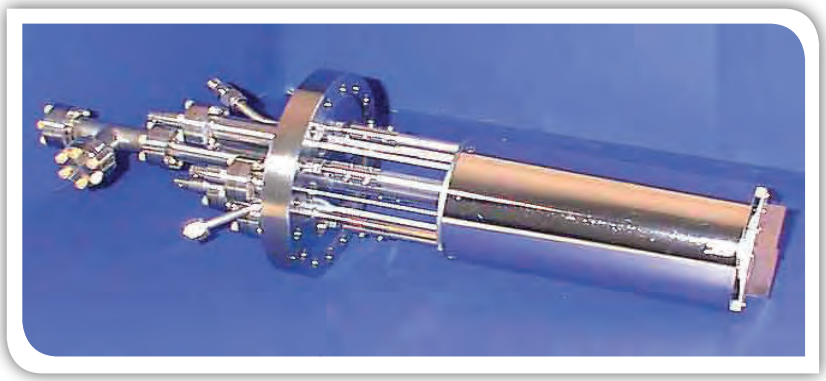
Substrate Heaters For High NH_3 Pressures

Model #NH-series substrate heaters use a proprietary heating filament material which has been shown to withstand NH_3 pressures up to several torr and temperatures up to 1,200 °C. The heat shields and electrical contacts are similarly treated for high pressure, high temperature operation. Uniformity is guaranteed ± 1% over 4" (101 mm).

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

High Performance RF Atom Sources for III-Nitride Materials

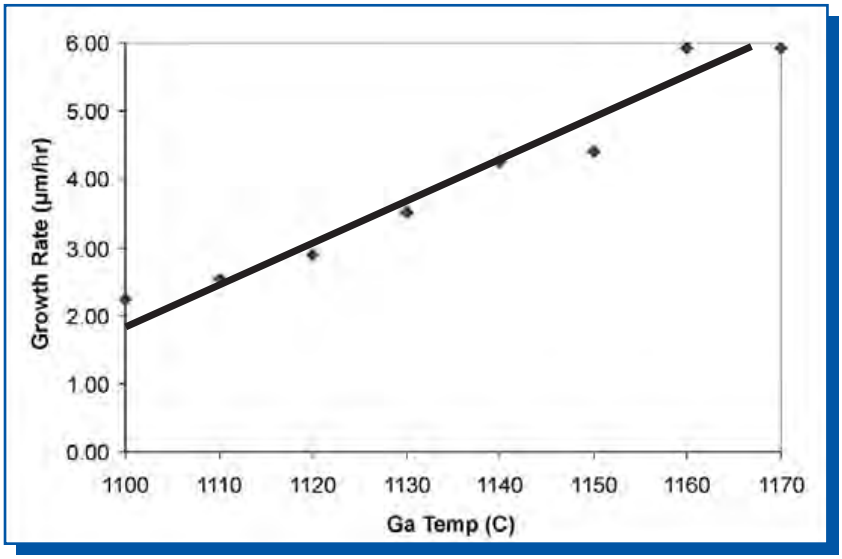
Engines for Thin Film Innovation

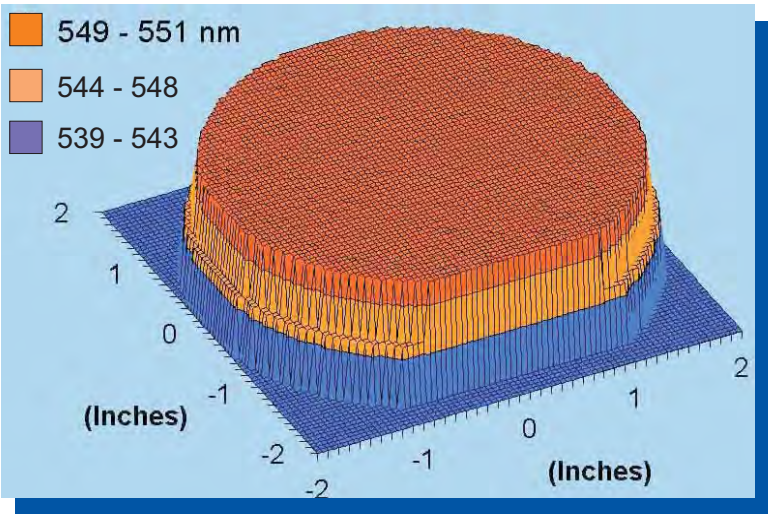


Features

- Growth Rates up to 6 m/hr
- Zero Ion Content
- Versatile Beam Shaping
- Real-time Flux Control
- Full Automation

Measured Growth Rate of GaN as a Function of Ga Cell Temperature *(See Application Note 1001)*



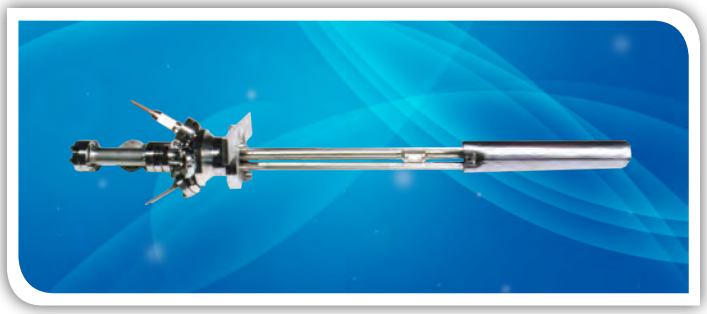


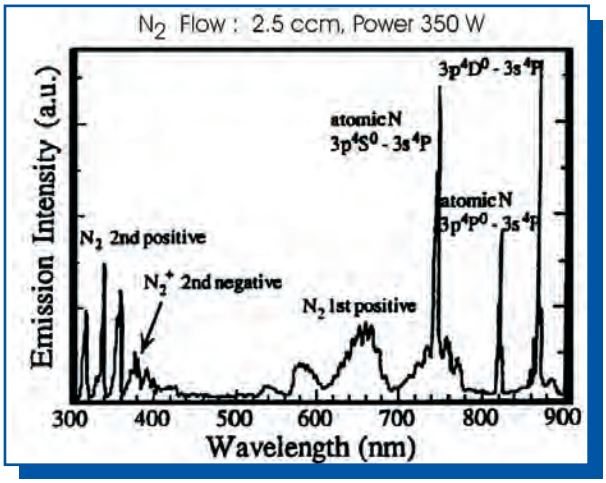
4" GaN Wafer Thickness Uniformity

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

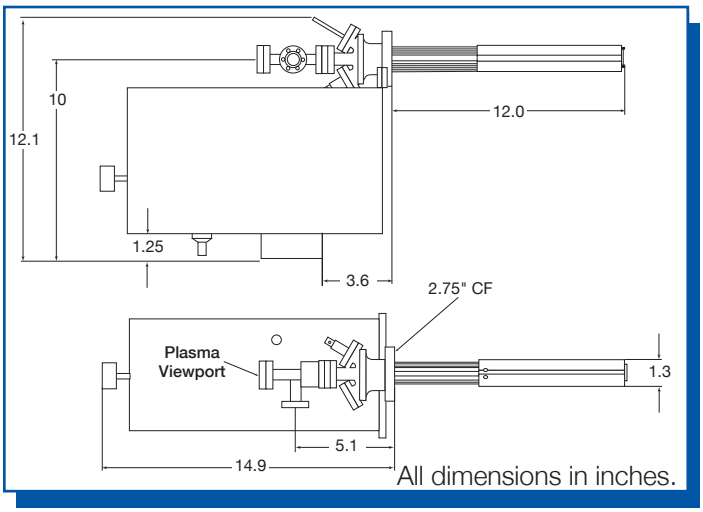
RF-2.75 Plasma Source

Engines for Thin Film Innovation





Nitrogen Plasma Emission Spectra of the SVTA-RF-2.75 Plasma Source



Description

- The RF-2.75 Compact RF Plasma Source is excellent for oxide and nitride deposition.
- The RF Plasma Source and manually tuned RF matching network mounts to a standard 2.75" CF (70 mm) Flange.
- Equipped with an optical viewport, the RF-2.75 Plasma Source is fully compatible with SVT Associates' RoboRF Automation Software.
- The integrated charge suppression ensures that ions do not reach the target and also eliminates substrate damage due to unintentional sputtering.

Features

- Compact Design
- Integrated Charge Suppression
- Automatic Tuning Network Available
- Optical Port for Plasma Monitoring
- Integral Water Cooling
- Custom Plasma Chamber and Aperture Available

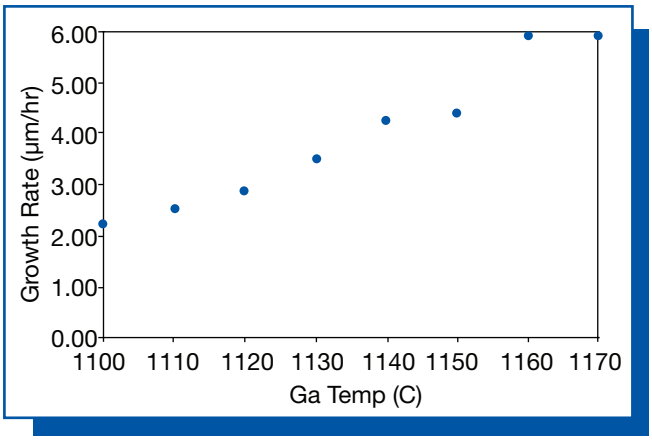
Specifications	
RF Power Level	150 – 400 Watts
Gas Flow Rate	0.1 – 5 SCCM
Flange	2.75" CF
Source Diameter	1.30"
Water Cooling	0.17 GPM Flow Rate
RF Matching Network	Manually Tuned
Plasma Chamber	PBN, Alumina, or Quartz

Model	Description
SVTA-RF-2.75PBN	PBN, 0.11" Aperture
SVTA-RF-2.75ALO	Alumina, 0.11" Aperture
SVTA-RF-2.75Q	Quartz, 0.11" Aperture

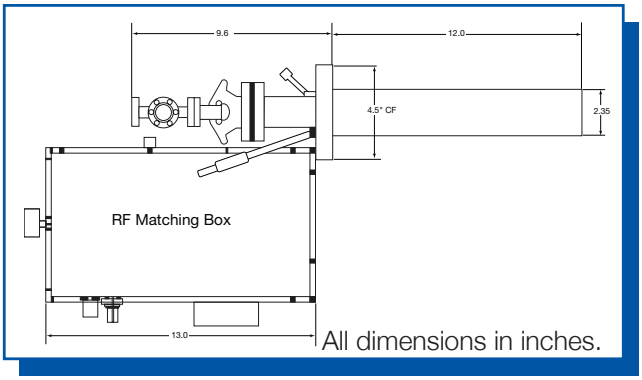
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

RF-4.5 Plasma Source

Engines for Thin Film Innovation



GaN Growth rate of SVT Associates' RF-4.53 Plasma Source in a SVT Associates' III/V MBE System *(See Application Note 1001)*



Description

- SVT Associates' RF-4.5 Plasma Source is designed to dissociate diatomic nitrogen, oxygen, and hydrogen without producing high energy ions.
- The "zero" ion content flux allows for high quality growths as well as cleaning of substrates for thin film deposition without damaging the surface.
- SVT Associates' RF-4.53 High Growth Rate Plasma Source is able to produce high quality growth rates greater than 4 µm/hr *(See Application Note 1001)*.
- Custom aperture and chamber designs are available upon request to tailor the flux to individual applications.
- Optional equipment such as RoboRF provide automated operation and allow the user to log data, as well as write recipes for reproducible growths.

Features

- N_2, O_2, and H_2 Models Available
- Growth Rates Up to 4 µm/hr
- Optical Port for Plasma Monitoring
- Custom Shaped Plasma Chamber and Apertures Available
- Automatic Tuning Network Available

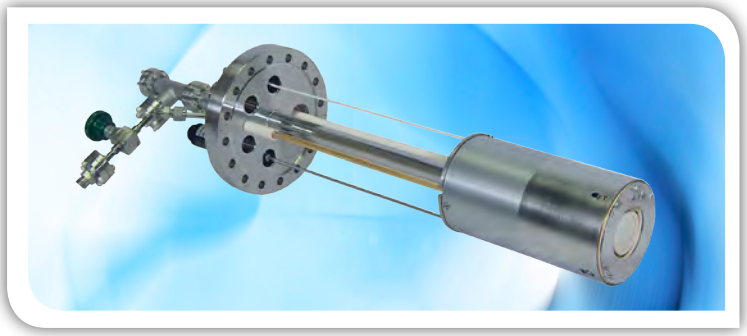
Specifications	
RF Power Level	200 – 600 Watts
Gas Flow Rate	0.1 – 5 SCCM
Flange	4.50" CF
Source Diameter	2.35"
Water Cooling	0.17 GPM Flow Rate
RF Matching Network	Manually Tuned Auto Tuning Optional
Plasma Chamber	PBN, Alumina, or Quartz

Model	Description
SVTA-RF-4.5PBN	PBN, 0.11" Aperture, Specify Length: 12" – 20"
SVTA-RF-4.5ALO	Alumina, 0.11" Aperture, Specify Length: 12" – 20"
SVTA-RF-4.5Q	Quartz Plasma Chamber, 0.11" Diameter Fused Hole
SVTA-RF-4.53	High Growth Rate Model

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

RF-6.02 Plasma Source

Engines for Thin Film Innovation

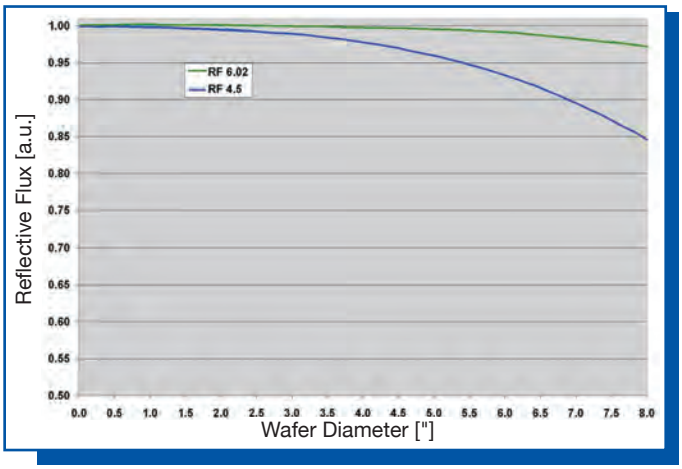


Description

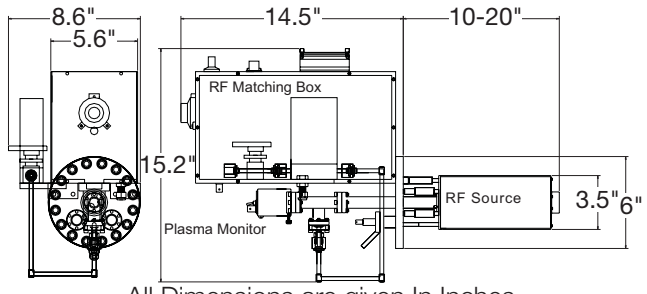
- The RF-6.02 is designed for high volume and large wafer size production systems for nitride and oxide thin film growth.
- Integrated Charge Suppression eliminates the high energy ions from the flux and reduces substrate sputtering.
- The large distribution area of the RF-6.02 is ideal for wafer sizes of 4" or larger.
- With efficient radical generation growth rates greater than 6 µm/hr are achieved under optimal growth conditions.

Features

- For N_2, O_2, and H_2
- Growth Rates Up to 6 µm/hr
- Flux Uniformity for Wafer Sizes Up to 8" Diameter
- Optical Port for Plasma Monitoring
- Custom Plasma Chamber and Apertures
- Automatic Tuning Matching Network
- Charge Suppression
- Fully Automated Plasma Source with Safety InterLock



Relative Flux Distribution of the
SVTA-RF-4.5 and SVTA-RF-6.02



All Dimensions are given In Inches

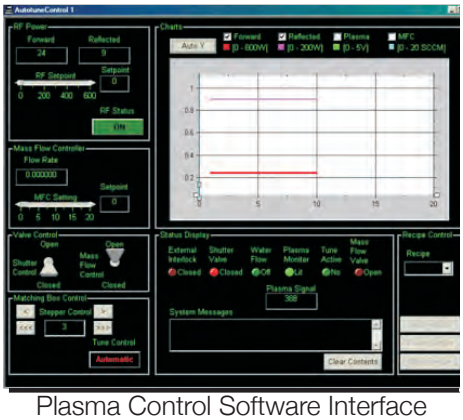
Specifications	
RF Power Level	200 – 2,000 Watts
Gas Flow Rate	0.1 – 10 SCCM
Flange	6.0" CF
Source Diameter	3.50" (89 mm)
Water Cooling	0.5 GPM
Source to Target Distance (Typical)	10.5"
Plasma Chamber	PBN, Alumina

Model	Description
SVTA-RF-6.02PBN	PBN, Specify Length: 10" – 20"
SVTA-RF-6.02ALO	Alumina, Specify Length: 10" – 20"

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Plasma Control System

Engines for Thin Film Innovation



Plasma Control Software Interface

Description

The RoboRF Plasma Control System is a multi-purpose interface that allows fully automated operation of the RF plasma sources. The system can be easily retrofitted to other existing RF plasma systems. A 19" rack mount electronic box with embedded microprocessor and an industry field bus protocol ensures reliable operation even in noisy production environments. The system monitors the plasma status and automatically controls the RF matching network, gas flow controllers, and the RF power supply for stable process source conditions and maximum RF efficiency.

The plasma monitor module is designed to communicate with SVT Associates' plasma emission monitor located at the view-port of the plasma source. The monitor signal is processed within the embedded control unit to monitor the plasma properties of the plasma source in real time.

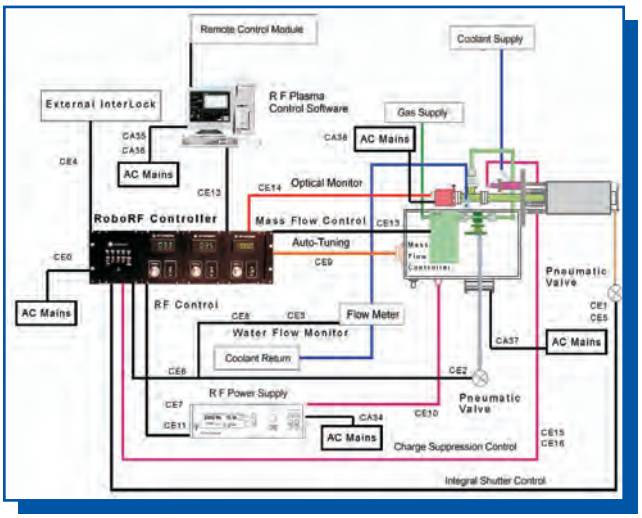
A user-friendly windows based control software allows easy operation of the RF plasma source and displays all plasma system parameters. Extensive data logging, processing and recipes capabilities, as well as remote operation of the plasma system are provided for quality control and process optimization.

RoboRF Controller

Features

- Automatic Tuning of the Plasma Source to the RF Power Supply
- Mass Flow Control with Automatic Feedback Control and Processing
- Data Logging of Parameters for Process Analysis and Quality Control
- User Interface to Remote PC or Remote Applications
- Plasma Status Monitoring and Plasma Control
- Cooling Water Flow Safety Interlock
- Microsoft Windows Environment and Monitoring Software

Model	Description
SVTA-RF-HVPS	High Voltage Supply for Charge Suppression Plates
SVTA-RF-RR	RoboRF Plasma Control System



Plasma Control System Schematic

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Ozone Gas Delivery System

Engines for Thin Film Innovation

Description

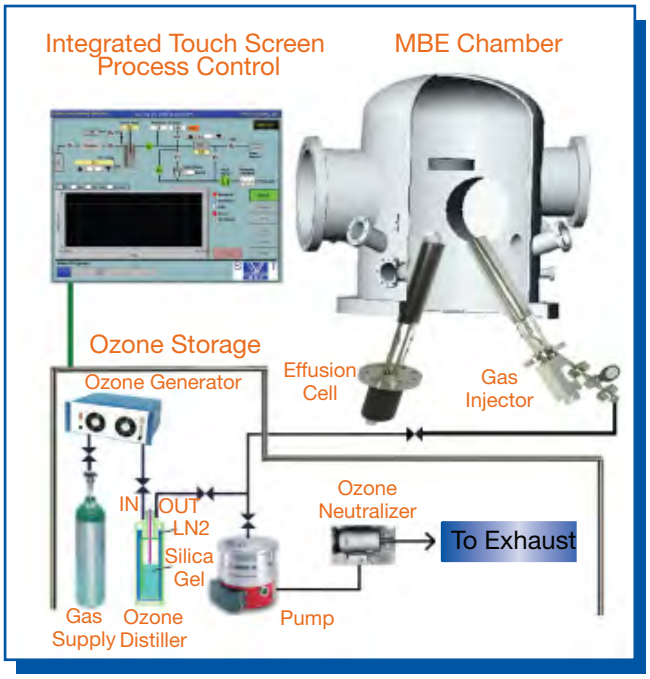
SVTA-O3 ozone gas delivery system is designed to provide ultra pure fluxes of ozone as a powerful oxidant in MBE and other vacuum deposition processes. It consists of three modules: the ozone generation, advanced gas handling, and ozone injection.

Ozone delivery is a two step process:

1. In charging mode, diatomic oxygen molecules are fed into an ozone generator and ozone is stored in a temperature regulated trap. After distillation, all remaining diatomic oxygen molecules are pumped into an exhaust system.

2. In deposition mode the trap is depleted using a computer controlled warm-up process and an automated gas delivery system. The gas is injected using SVT Associates' water cooled ozone injector source. The materials of all wetted parts are chosen to minimize recombination of produced ozone for high efficiencies.

The turn-key system is stand alone retrofittable to any MBE system. The integrated touchscreen control unit provides ease of operation and a small laboratory footprint.

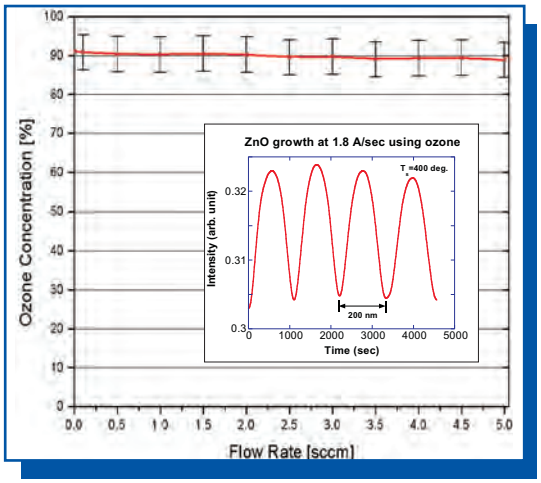


SVTA-O3 Delivery System for a MBE System

Features

- Fully Enclosed Gas Cabinet with Safety Gas Monitor
- Precise Capacitance Based Flow Regulation
- Abrupt Run/Vent Operation with Short Gas Lines to the Source Injector
- RoboMBE™ Computer Controlled Remote Operation

Specifications	
Utility Ratio	1 hr charge/10 hr operation
Ozone Flux	*3 x 10^{16} molecules/cm^2 s
Flange Mount (CFF)	2.75", 4.50" or 6.00"
Cooling	Liquid N_2
Size	26" x 18" x 78" (66 cm x 46 cm x 200 cm)
*Operating Pressure at 1.0 x 10^{-5} Torr	

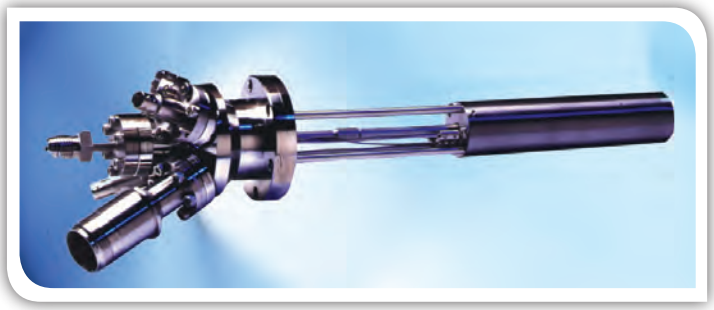


Very high and stable ozone concentration over a wide flow rate range.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Atomic Hydrogen Source

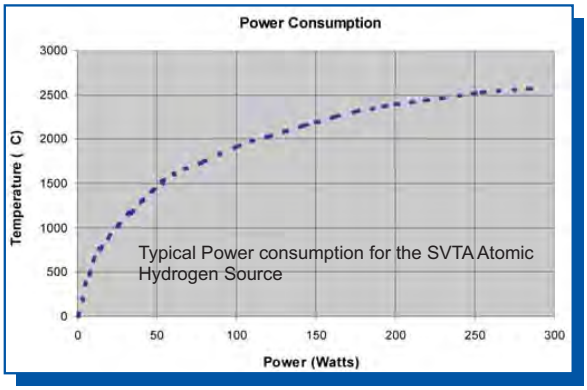
Engines for Thin Film Innovation

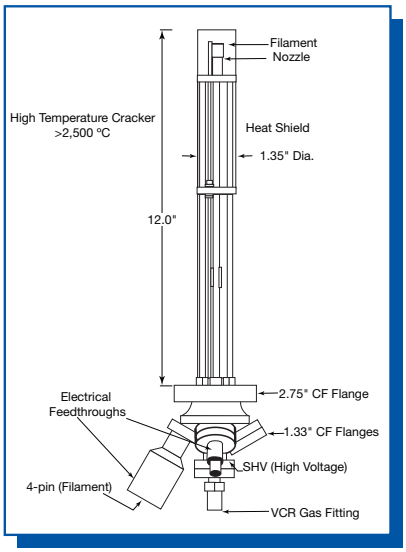


Description

The Atomic Hydrogen Source operates on the principle of electron beam heating. It can produce temperatures up to 2,500 °C. Hydrogen gas is introduced and thermally cracked to produce only atomic hydrogen. It does not produce ionized species, and therefore eliminates the possibility of damage to the substrate, making it an excellent tool for substrate cleaning.

The compact SVTA-H1-1 mounts on a standard 2.75" (70 mm) CF flange. An adapter flange is available for larger port sizes, making the compact SVTA-H1-1 retrofittable to any MBE systems. The recommended power supply for the atomic hydrogen is SVTA-H1-PS. The atomic hydrogen power supply consists of three individual supplies. A high voltage supply provides the source bias, a high current supply provides the filament power, and a controller is connected to the other two supplies and maintains the output emission current. It also provides the flux monitor bias while measuring and displaying flux monitor current.

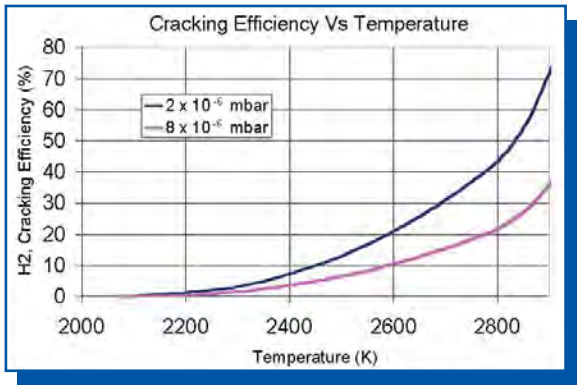




Schematic drawing of the Atomic Hydrogen Source

Specifications	
Power	300 W
Emission Current	100 mA
Temperature	2,873 K
Filament Current	15 A
Tube Material	W, Mo
Electrical Connectors	Filaments: Amphenol Circular High Voltage: SHV
Mounting Flange	2.75" (70 mm) 4.50" (114 mm) CFF
In-Vacuum Length	12" (or Custom)
Option	Water Shroud

Model	Description
SVTA-H1-1	12" Length Hydrogen Source
SVTA-H1-PS	Power Supply
SVTA-H1-PSC	Power Supply Cable



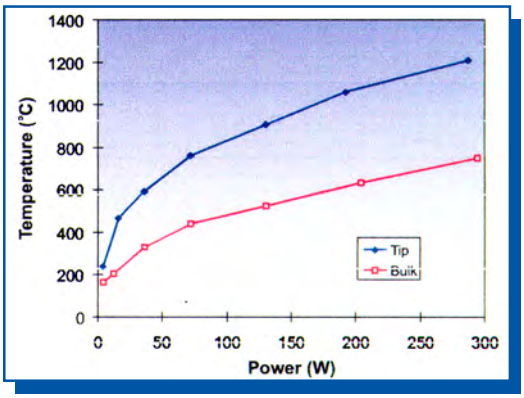
This curve shows the cracking efficiency for the SVTA-H1-1 source. The H_2 flow rate will vary according to the system type and application. The best working conditions are strongly dependent on the H_2 pressure and the gas flow rate.

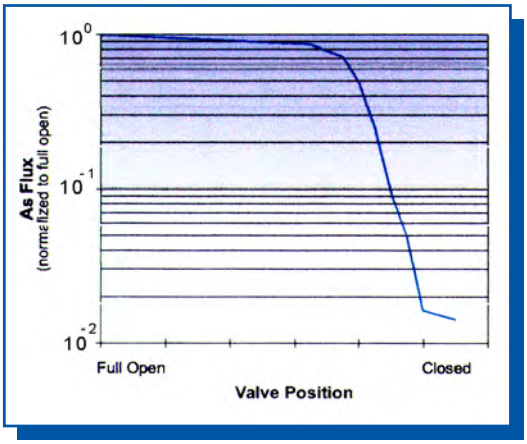
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

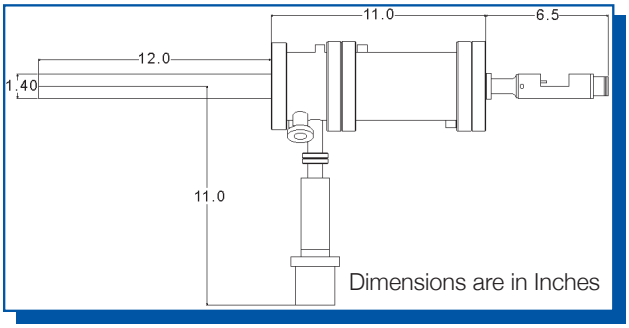
Arsenic Valved Cracker

Engines for Thin Film Innovation

SVTA-VC-45-AS







Description

The SVTA-VC-45 Arsenic valved cracker provides optimal cracking efficiency and excellent flux uniformity for quality growth of III-V materials. Its unique design features two independently controlled thermal zones for the bulk evaporator and cracking head for generating pure Arsenic (As_2) fluxes. The integrated water-cooling jackets for the bulk evaporator and valve body provide efficient cooling for the source.

A high purity crucible and selected materials for the cracking tube assembly guarantee high purity operating conditions. Implementation of the optional computer controlled valve (SVTA-VC-ACM) mechanism allows expanding versatility. It allows for precise and rapid control over the valve position during growth. The valve function can be integrated with RoboMBE process software. The valve aids in material growth and repeatability, but also eliminates charge oxidation while the growth chamber is up to atmospheric pressure for refilling other source charges.

SVT Associates offers 200 cc and 500 cc capacity.

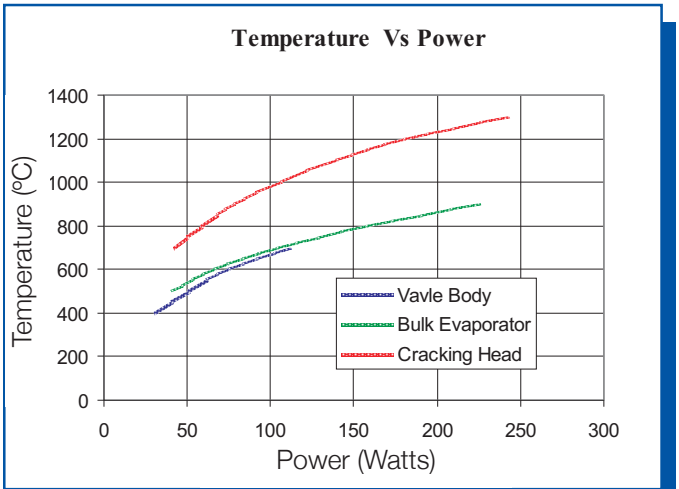
Specifications	
Crucible Size	200 cc, 500 cc
Temperature (Bulk, Cracking Head)	Ambient to 800/1,200 °C
Power (Bulk, Cracking Head)	0 – 160/320 Watts
Temperature Stability	+/- 0.1 °C
Thermocouple	Type C
Standard in Vacuum Length	12" (30.5 cm)
Mounting Flange	4.50" CF
Electrical Connectors	Filament: Amphenol Circular T/C: Omega Subminiature
Access	25' Cables (VCEC-25)
Optional Equipment	Power Supply (VCPS-2) Temperature Controller (VCTC-2) Motorized Valve and Controller (VC45-MRS)

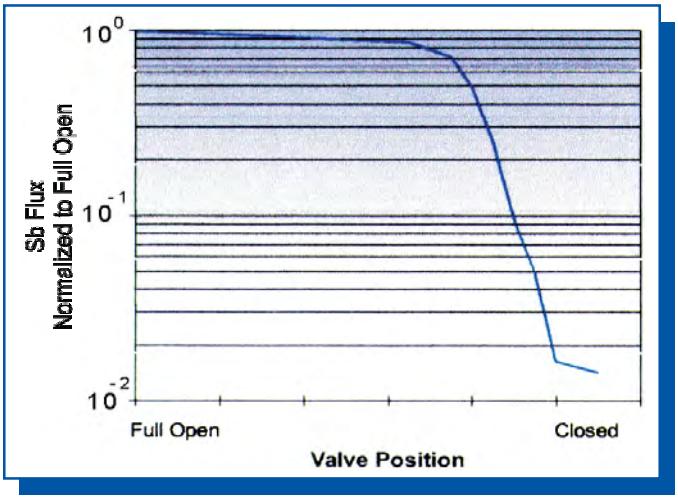
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Antimony Valved Cracker

Engines for Thin Film Innovation

SVTA-VC-45-SB





Description

SVT Associates' Antimony Valved Cracker provides efficient, reliable, and ultra-pure Antimony flux in a UHV environment. The Antimony Valved Cracker has three independently controlled thermal zones, water cooling jackets for the bulk evaporator and valve body, a high purity cracking tube assembly and a PBN Reservoir. The Antimony Valved Cracker comes standard with manually controlled needle valve actuation. A computer controlled package is available for instant flux beam valve control. As with all of SVT Associates' Vacuum Components, each source is carefully tested and characterized before shipment.

Features

- Needle Valve Design For Enhanced Flux Control
- Three Independently Controlled Thermal Zones for Efficient Sb Evaporation and Cracking
- Optional Motorized Valve Package for Instant Flux Control

Specifications

Crucible Size	200 cc, 500 cc
Temperature (Bulk, Cracking Head)	Ambient to 800/1,200 °C
Power (Bulk, Cracking Head)	0 – 160/320 Watts
Temperature Stability	+ 0.1 °C
Thermocouple	Type C
Standard in Vacuum Length	12" (30.5 cm)
Mounting Flange	2.75" or 4.50" CF
Electrical Connectors	Filament: Amphenol Circular T/C: Omega Subminiature
Access	25' (7.62 m) Cables (VCEC-25)
Optional Equipment	Power Supply (VCPS-1) Temperature Controller (VCTC-1) Motorized Valve and Controller (VC45-MRS)

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Phosphorous Valved Cracker

Engines for Thin Film Innovation

SVTA-VC-45-P

Description

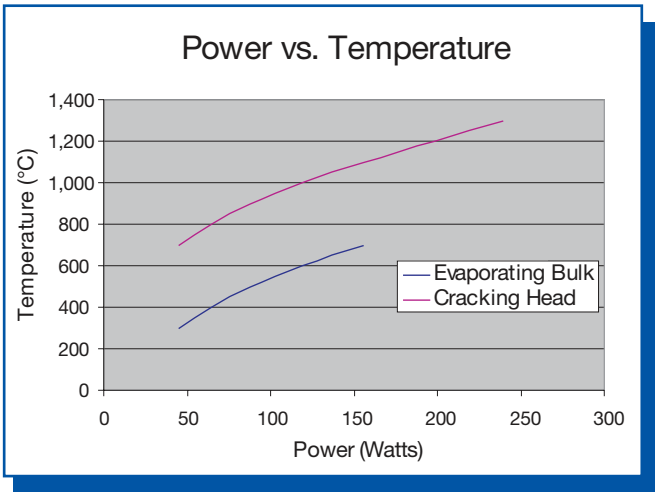
SVT Associates' Phosphorus Valved Cracker provides efficient, reliable, and ultrapure phosphorus flux in a UHV environment. The source has three independently controlled thermal zones with thermal isolation for optimum in-situ conversion as well as reproducible evaporation. All heaters ensure proper outgassing, while water cooling is used to promote condensation in the reservoir region. Conversion from red to white Phosphorus ensures reproducible and safe low temperature evaporation from the reservoir. An all-metal needle valve allows rapid flux adjustment during operation. Cracking of the flux to P_2 occurs in the high temperature cracking zone. An optional motor controlled valve is available for instantaneous flux control through feedback loop or for remote operation in process recipes.

Features

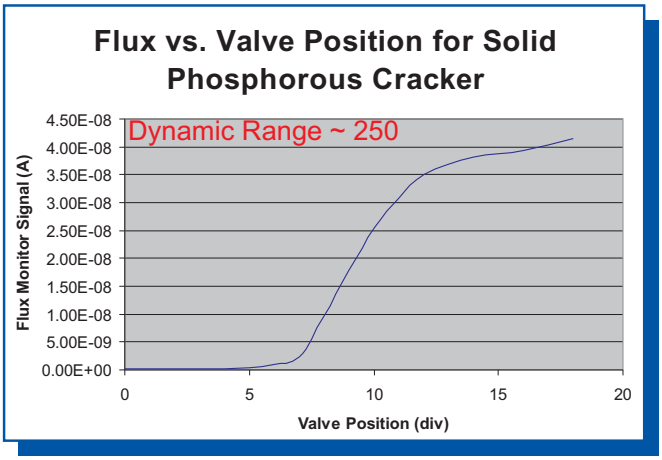
- Optimum temperature control for safe and reliable use
- Ultra-clean operation
- Precision valve for shut-off and flux control
- Optional gate valve integration for refilling without venting

Typical Applications

- Quaternary group V materials
- GaInP/AlGaInP Laser Diodes
- AlGaInP LEDs
- GaAs/GaInP heterostructures



The typical power consumption for a 500 cc Phosphorous Valved Cracker



Specifications	
Crucible Size	200 cc, 500 cc
Typical Temperatures	
Cracking Head	1,000 °C
Bulk	200 °C
Reservoir	< 100 °C
Temperature Stability	+/-0.1 °C
In Vacuum Length	12"
In Vacuum Diameter	1.4"
Mounting Flange	4.5" CF
Valve Speed (Full Open/Close)	< 3s
Flux Range	> 2 Decades

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Gas Injector – SVTA-APH3-GCS

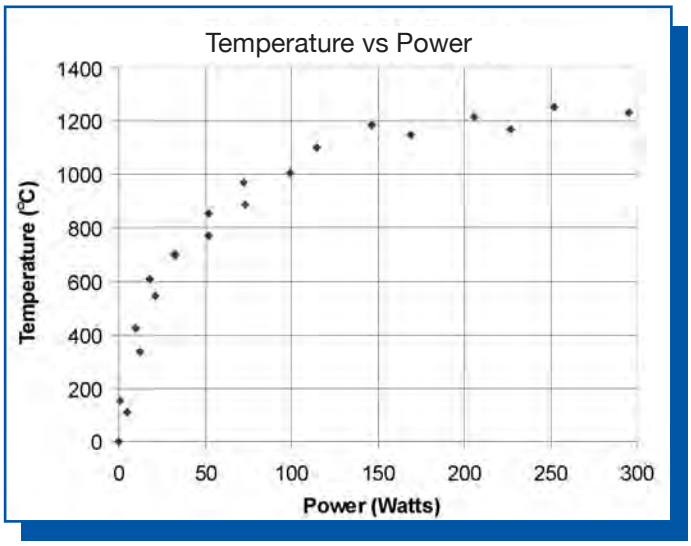
Engines for Thin Film Innovation

Description

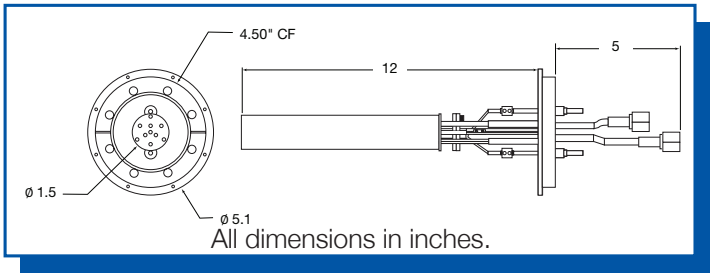
SVT Associates' gas injectors are specially designed for gas source molecular beam epitaxy (GSMBE). The SVTA-APH3-GCS injector is designed to crack Arsine and Phosphine to provide high quality growth of III-V materials. The source uses a single filament heater and a dual gas tube furnace for high efficiency gas cracking. It also utilizes a series of aperture plates to ensure proper cracking performance. The cracking hot zone is made of high purity PBN and Tantalum materials providing a high purity operation at the highest temperatures. A complete system requires a pressure based gas handling system. Custom lengths are available for best uniformity distribution.

Typical Applications

- For III-V Material Systems
- High Gas Cracking Performance
- Advanced Gas Handling System
- Temperature 150 °C – 1,300 °C
- MFC/Automated Flux Control



Typical power consumption for a single filament dual gas injector.



Schematic drawing of a dual gas injector. Dimensions are given in Inches.

Specifications

Temperature Range	0 °C – 1,300 °C
Power Requirement	0 – 300 Watts
Temperature Stability	+/- 0.1 °C
Temperature Reproducibility	0.1 °C
Thermocouple Type	Type C
Standard In-Vacuum Length	12.0"
Mounting Flange	4.5" CFF
Electrical Connectors	Filament: Amphenol Circular T/C: Omega Submini
Gas Connection	(2) 1.33" CFF

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

CBr_4 Gas Injector

Engines for Thin Film Innovation

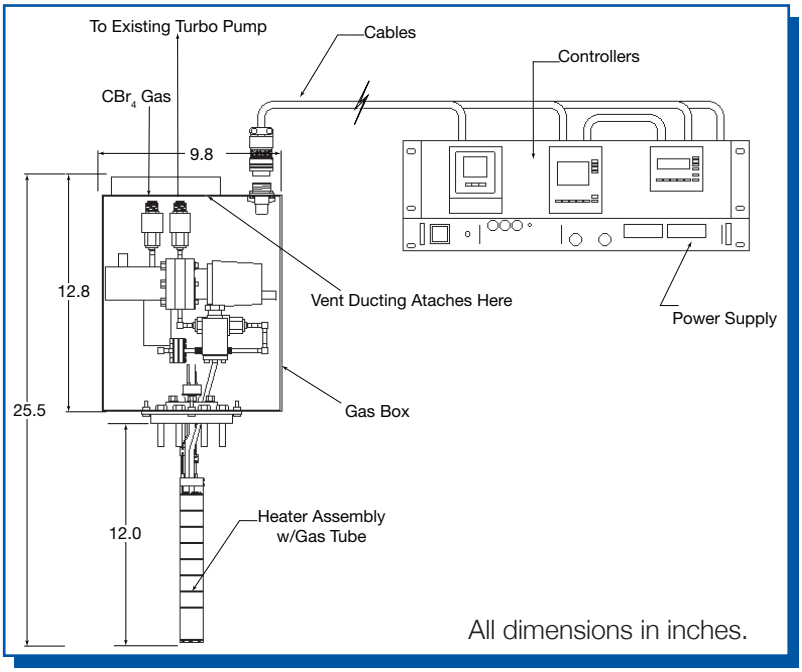
Description

Carbon Tetrabromide (CBr_4) is an excellent choice as a p-type dopant used in III-V materials. It is sufficiently versatile in MBE deposition techniques where very accurate and reproducible p-type doping of epitaxial materials is required.

SVT Associates' CBr_4 module is easily adaptable to any MBE system with safety and ease of operation the major features of the design. The gas handling system is enclosed within a safety gas cabinet. Carbon Tetrabromide is introduced by using a pressure control system to control the flow of vapor. The gas panel allows the user to precisely control the introduction of low flow rate CBr_4 into the growth Chamber.

Features

- Adaptable to any MBE System
- High Performance Gas Injector
- Advanced Gas Handling System
- Safety and Simple Operation



Schematic drawing of the CBr_4 delivery module.

Components

GAS INJECTOR SOURCE

- Gas Injector with Heater *(Custom Lengths Available)*
- Temperature Controller *(Rack Mountable)*
- Double Jacketed Gas Lines

GAS HANDLING SYSTEM

- External Manual Adjustable Valves
- Thermal Leak Valve and Controller
- Cold Cathode Gauge and Controller

OPTIONS

- Pneumatic Valves
- Pneumatic Valve Controller
- Bakeout for Gas Lines

Model	Flange Size (CFF)
SVTA-CBR4-275	2.75" CF (70 mm)
SVTA-CBR4-450	4.50" CF (114 mm)
SVTA-CBR4-600	6.00" CF (152 mm)

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Advanced Gas Source Control

Engines for Thin Film Innovation

Description

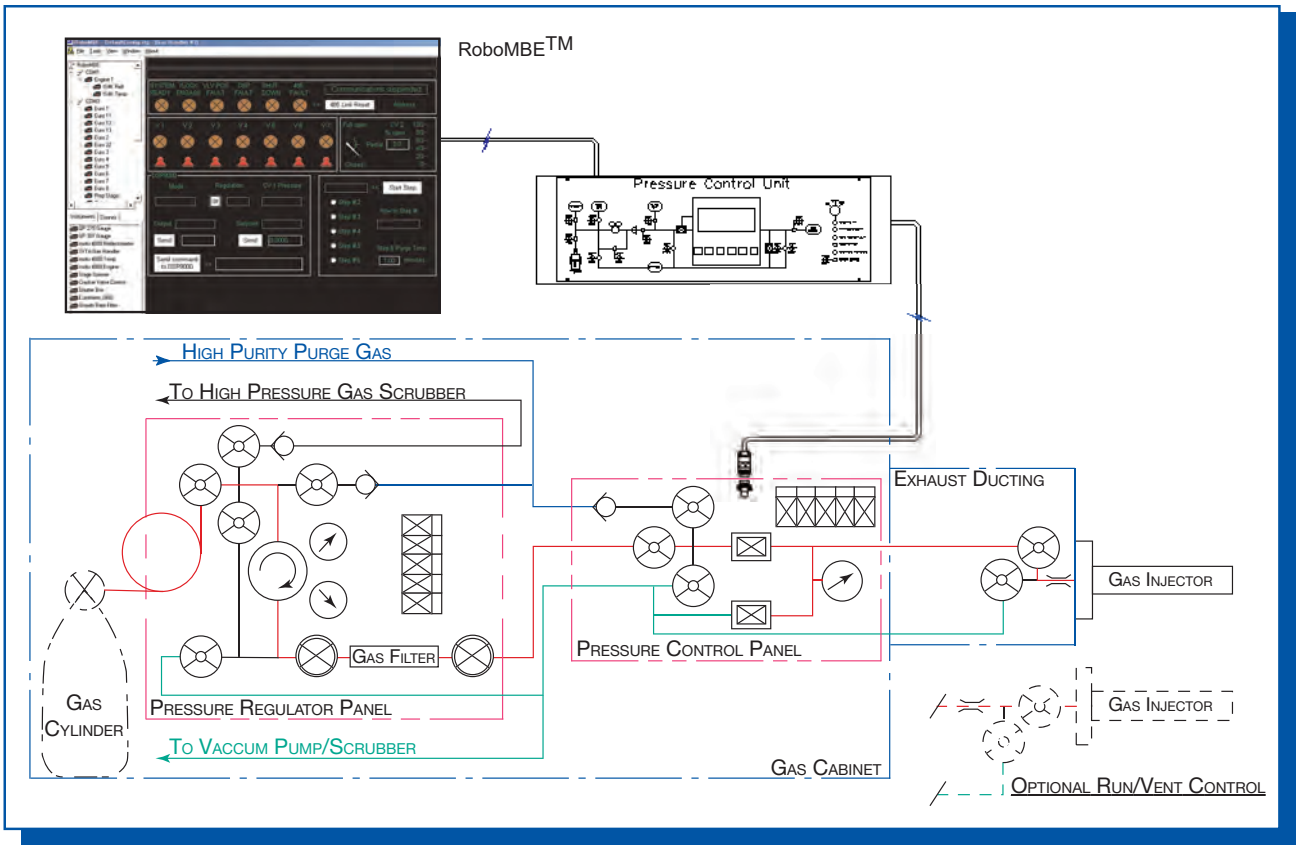
The system is designed to deliver gas from the cylinder to the MBE system in a precisely controlled manner. A pressure control algorithm is used to accomplish this task and to minimize gas transient. The gas is delivered to the upstream side of a precision orifice of known conductance at a precisely controlled set point pressure. From the upstream pressure and the conductance of the orifice, the mass flow rate into the injector can be calculated.

The orifice and start/stop valves are located on the injector to ensure an abrupt on/off control of the gas supply to the injector. For toxic gasses, the pressure control panel, regulator panel, and gas bottle are located in a gas cabinet.

The pressure set point and control valves are controlled from a 19" rack mountable pressure control unit. This unit allows manual control of the required valves and set point pressure. An onboard microprocessor controls the required valves to maintain the set point pressure. The pressure control unit can also be remotely controlled by RoboMBE™ process automation software.

Features

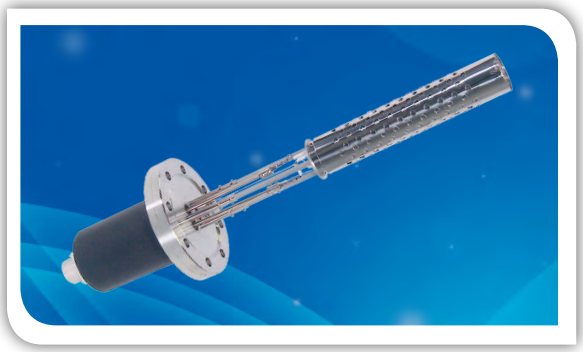
- Remote operation of valves and set point pressure (RoboMBE Automation Compatible)
- Abrupt Start/Stop of Gas Flow into Injector
- Reproducibility of better than 0.2% of Maximum sccm
- Precise control over a three decade range of sccm
- Electropolished (<10 Ra) stainless steel gas components
- Run-Vent Control Option



7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Effusion Cells

Engines for Thin Film Innovation



Low Temperature

High Temperature

Description

- Sizes from 5 cc – 150 cc
- Outstanding Performance from 150 °C – 2,000 °C
- Special Sources for oxides and nitrides

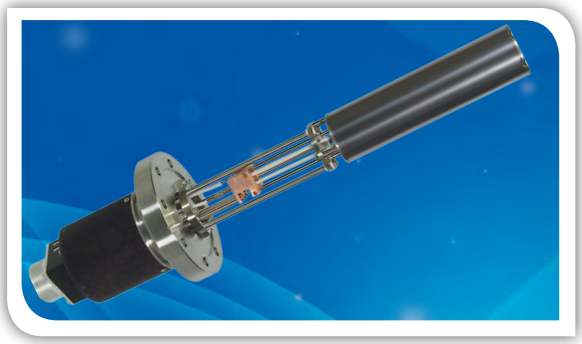
Configured Power Supply and Controller

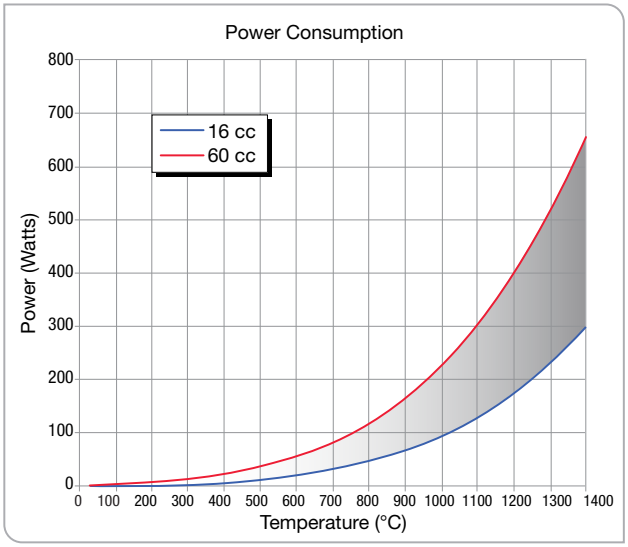
Model	Description	Materials (Partial Listing)
HL Series	Hot Lip	Ga, In, Au, Ag
CL Series	Cold Lip	Al
HT Series	High Temperature	B, Co, Cr, Fe, Ni, Pt, Pd, Y, La
LT Series	Low Temperature (1,000 °C)	As, Ba, Bi, Ca, Cd, Mg, Na, Pb, Sr
DF Series	Dual Filament	Cu, Ga, In, Dy
Excel Series	Low Temperature (600 °C)	Organic Compounds

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Single Filament Effusion Cell – SF Series

Engines for Thin Film Innovation





Typical power consumption of 16 cc – 60 cc Single Filament Cells.

SVTA-SF-(Crucible Size)-(Flange Size)			
Flange Size	2.75"	4.50"	6.00"
Crucible Size	6 cc 10 cc 16 cc 20 cc 22 cc 40 cc	16 cc 20 cc 22 cc 40 cc 50 cc 60 cc 80 cc 85 cc	85 cc 100 cc 150 cc
Larger sizes available for the 6.00" flange size, contact SVT Associates for details.			

Description

SVT Associates' SF Series is the perfect choice for a general purpose source heater for Germanium and related materials. Its single filament design heats the crucible uniformly for evaporation of materials. Models are available for mounting on a 2.75" or larger CF flange. SVT Associates' effusion cells are thoroughly tested and characterized before shipment. Water cooling shrouds and integral shutters are optional for 4.50" CF flange or larger.

Features

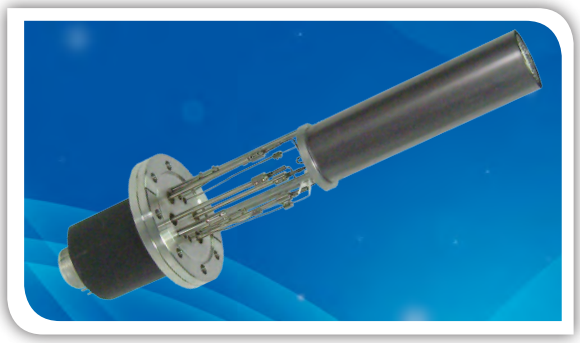
- High Performance Components
- Wide Range of Accesories
- Integral Water Cooling and Shutters
- Sturdy All Tantalum and PBN Hot Zone

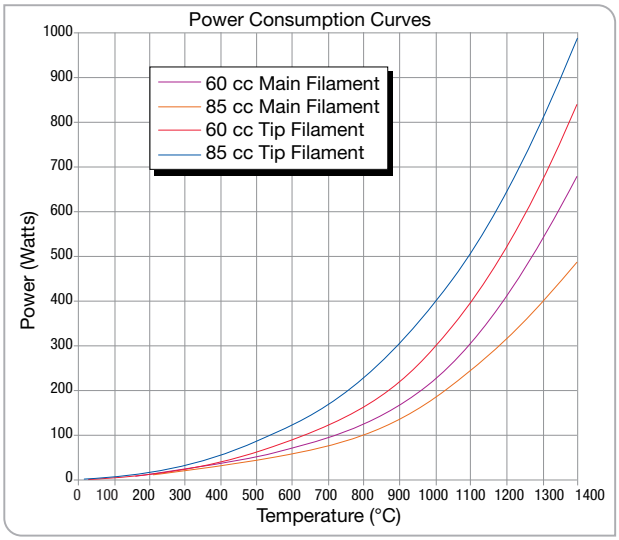
Specifications	
Temperature Range	0 °C – 1,400 °C
Power Requirement	600 W or 1kW
Temperature Stability	+/- 0.1 °C
Temperature Reproducibility	+/- 0.1 °C
Thermocouple Type	Type C (Type D Available)
Crucible Size*	6 cc, 10 cc, 16 cc, 20 cc, 22 cc, 40 cc, 50 cc, 60 cc, 80 cc, 85 cc, 100 cc, 150 cc Crucibles have tapered wall for best coverage.
Materials*	PBN and Aluminum Oxide
Standard Length*	12.0"
Mounting Flange	2.75", 4.50" or 6.0" OD – CF
Electrical Connectors	Filament: Amphenol Circular T/C: Omega Submini
*Other sizes, materials, and lengths are available, contact SVT Associates for details.	

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Dual Filament Effusion Cell – DF Series

Engines for Thin Film Innovation





Typical power consumption of 60 cc – 85 cc Dual Filament Cells.

SVTA-DF-(Crucible Size)-(Flange Size)			
Flange Size	2.75"	4.50"	6.00"
Crucible Size	6 cc	6 cc	6 cc
	10 cc	10 cc	10 cc
	16 cc	16 cc	16 cc
	20 cc	20 cc	20 cc
	22 cc	22 cc	22 cc
	40 cc	40 cc	40 cc
		50 cc	50 cc
		60 cc	60 cc
		80 cc	80 cc
		85 cc	85 cc
		100 cc	100 cc
			150 cc

Larger sizes available for the 6.00" flange size, contact SVT Associates for details.

Description

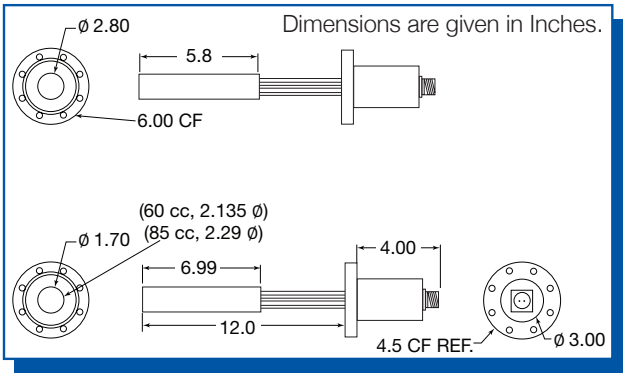
SVT Associates' DF Series is designed for use with Ga and In. Two Independently controlled filaments offer the user greater freedom to grow optimal materials. This source is available for mounting on a 4.50" or larger CF flange. SVT Associates' effusion cells are thoroughly tested and characterized before shipment.

Features

- Excellent Source for Ga and In
- Two Independent Filaments for Complete Temperature Control
- Wide Range of Sizes Available
- Compatible with any MBE System

Specifications	
Temperature Range	0 °C – 1,400 °C
Power Requirement	600 W or 1kW
Temperature Stability	+/- 0.1 °C
Temperature Reproducibility	+/- 0.1 °C
Thermocouple Type	Type C (Type D Available)
Crucible Size*	6 cc, 10 cc, 16 cc, 20 cc, 22 cc, 40 cc, 50 cc, 60 cc, 80 cc, 85 cc, 100 cc, and 150 cc Crucibles have tapered wall for best coverage
Materials*	PBN and Aluminum Oxide
Standard Length*	12.0"
Mounting Flange	2.75", 4.50" or 6.0" OD – CF
Electrical Connectors	Filament: Amphenol Circular T/C: Omega Submini

*Other sizes, materials, and lengths are available, contact SVT Associates for details.

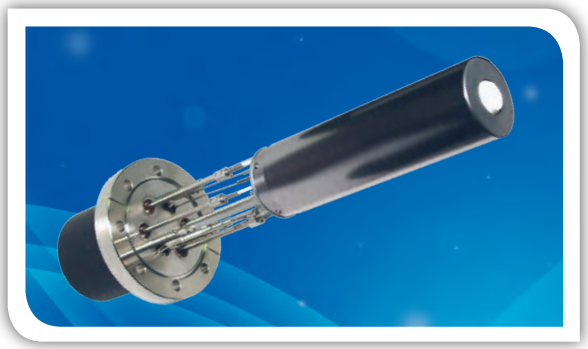


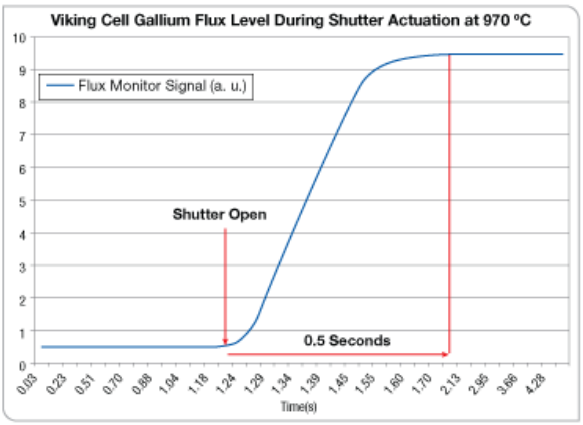
Schematic drawing of dual filament effusion cells.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

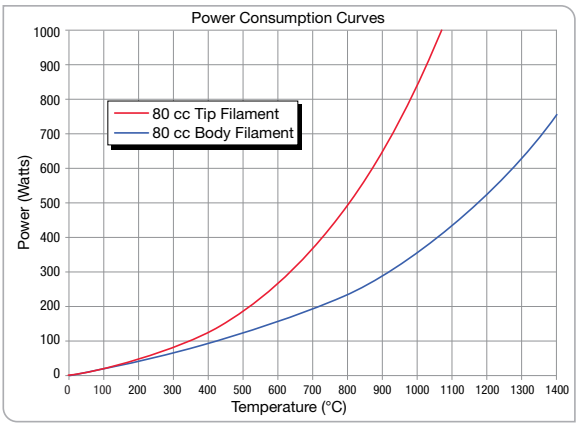
Viking Effusion Cell – V Series

Engines for Thin Film Innovation





The Viking Effusion Cell eliminates flux instabilities found in other effusion cells caused by shutter operation.



Typical Power Consumption for 80 cc Viking Effuison Cell.

Description

The Viking Effusion Cell is designed for highest growth quality of III/V compounds of Ga and In. The proprietary design maximizes capacity, while increasing uniformity and long term flux stability. The Viking is ideal for application with abrupt interfaces and long growth campaigns. The design eliminates shutter transient and "spitting" experienced with other effusion cells. With a fully enclosed filament, the Viking is compatible with corrosive environments such as ammonia and oxygen backgrounds. The innovative material specific, shaped crucibles provide the highest flux stability, while remaining simple to load material.

Features

- Excellent Source for Ga and In
- Two Independent Filaments for Complete Temperature Control
- "Zero" Flux Transient
- Designed for Corrosive Environments
- Long-term Flux Stability

Specifications	
Temperature Range	0 °C – 1,400 °C
Power Requirement	600 W or 1kW
Temperature Stability	+/- 0.1 °C
Temperature Reproducibility	+/- 0.1 °C
Thermocouple Type	Type C (Type D Available)
Crucible Sizes*	40 cc, 60 cc, 80 cc, 120 cc
Materials*	PBN and Aluminum Oxide
Standard Length*	12.0"
Mounting Flange	4.50" or larger CF Flange
Electrical Connectors	Filament: Amphenol Circular T/C: Omega Subminiature

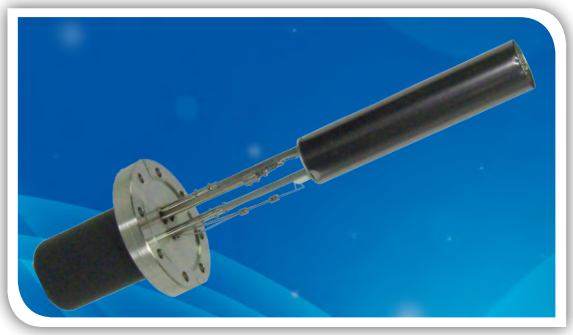
*Other sizes, materials, and lengths are available, contact SVT Associates for details.

SVTA-V-(Crucible Size)-(Flange Size)	
Flange Size	4.50"
Crucible Size	20 cc 22 cc 40 cc 50 cc 60 cc 80 cc 120 cc

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

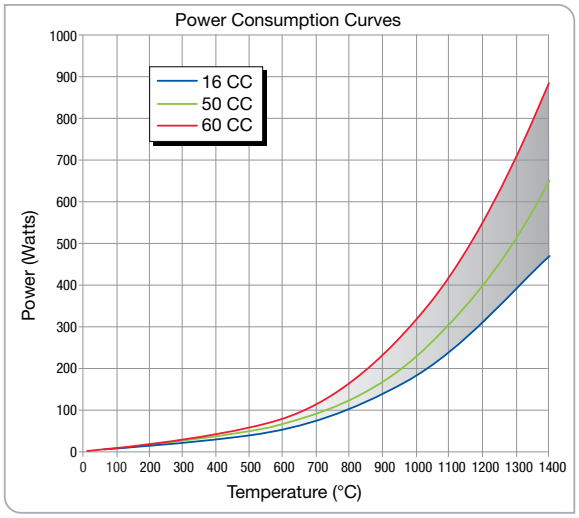
Hot-Lip Effusion Cell – HL Series

Engines for Thin Film Innovation



Description

SVT Associates' HL Series is designed for materials that require a higher temperature near the lip of the crucible. The hot-lip source has a primary full length filament that maintains a uniform temperature over the length of the crucible and provides a higher temperature at the lip, preventing condensation of materials such as Ga and In from forming on the crucible lip during evaporation. A single power supply, temperature controller and cable runs the cell. This source is available for mounting on a 2.75" or larger CF flange. As an option, water cooling shrouds and integral shutters require a 4.50" CF Flange or larger.



Typical power consumption of 16 cc – 60 cc Hot-Lip Effusion Cells.

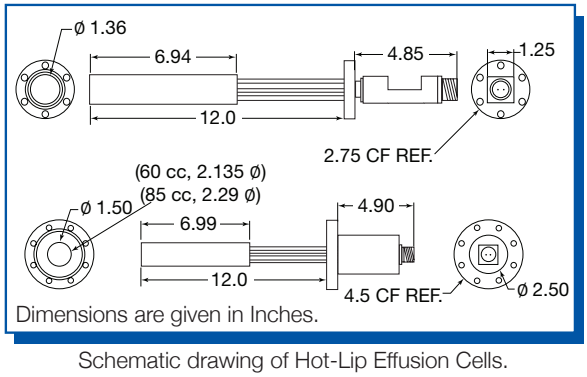
Features

- For III-V MBE System
- "Hot-Lip" Style Filament Design
- Excellent Source for Ga and In
- Wide Range of Sizes Available

Specifications	
Temperature Range	0 °C – 1,400 °C 1,600 °C Model Available
Power Requirement	600 W or 1kW
Temperature Stability	+/- 0.1 °C
Temperature Reproducibility	0.1 °C
Thermocouple Type	Type C (Type D Available)
Crucible Size*	6 cc, 10 cc, 16 cc, 20 cc, 22 cc, 40 cc, 50 cc, 60 cc, 80 cc, 85 cc Crucibles have a tapered wall for best coverage.
Materials*	PBN and Aluminum Oxide
Standard Length*	12.0"
Mounting Flange	2.75", 4.50" or 6.0" OD – CF
Electrical Connectors	Filament: Amphenol Circular

*Other sizes, materials, and lengths are available, contact SVT Associates for details.

SVTA-HL-(Crucible Size)-(Flange Size)			
Flange Size	2.75"	4.50"	6.00"
Crucible Size	6 cc 10 cc 16 cc 20 cc 22 cc 40 cc	6 cc 10 cc 16 cc 20 cc 22 cc 40 cc 50 cc 60 cc 80 cc 85 cc	16 cc 20 cc 22 cc 40 cc 50 cc 60 cc 80 cc 85 cc
Larger sizes available for the 6.00" flange size, contact SVT Associates for details.			

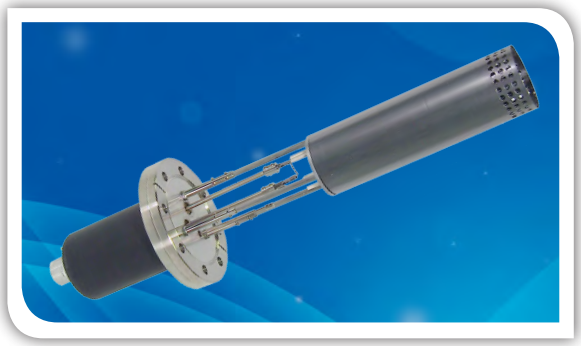


Schematic drawing of Hot-Lip Effusion Cells.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Cold-Lip Effusion Cell – CL Series

Engines for Thin Film Innovation

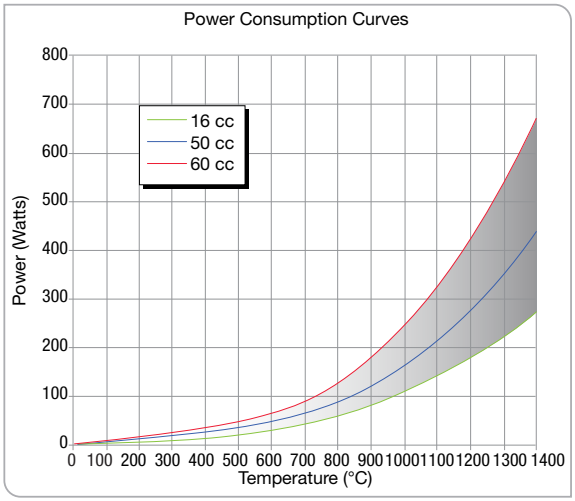


Description

SVT Associates' CL Series is used when depositing Aluminum. The cold-lip prevents Aluminum from wetting the crucible and damaging the cell during evaporation. Models are available for mounting on a 2.75" or larger CF Flange. SVT Associates also offers a cold-lip source with water cooling in the lip region for use in an UHV Ammonia environment. This source is available for mounting on a 4.50" or larger CF Flange. Water cooling shrouds and integral shutters are optional for 4.50" CF flange or larger.

Features

- For III-V MBE System
- Excellent Source for Al
- "Cold-Lip" Style Filament Design
- Wide Range of Sizes Available



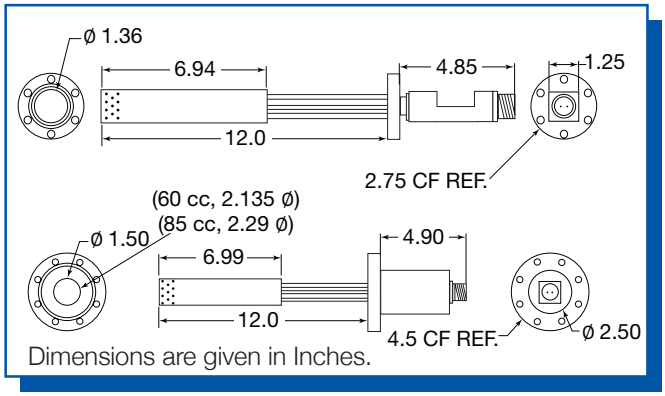
Typical power consumption of 16 cc – 60 cc Cold-Lip Cell.

Specifications	
Temperature Range	0 °C – 1,400 °C
Power Requirement	600 W or 1kW
Temperature Stability	+/- 0.1 °C
Temperature Reproducibility	+/- 0.1 °C
Thermocouple Type	Type C (Type D Available)
Crucible Size*	16 cc, 20 cc, 22 cc, 40 cc, 50 cc, 60 cc, 85 cc Crucibles have tapered wall for best coverage.
Materials*	PBN and Aluminum Oxide
Standard Length*	12.0"
Mounting Flange	2.75", 4.50" or 6.0" OD – CF
Electrical Connectors	Filament: Amphenol Circular T/C: Omega Submini

*Other sizes, materials, and lengths are available, contact SVT Associates for details.

SVTA-CL-(Crucible Size)-(Flange Size)			
Flange Size	2.75"	4.50"	6.00"
Crucible Size	6 cc 10 cc 16 cc 20 cc 22 cc 40 cc	16 cc 20 cc 22 cc 40 cc 50 cc 60 cc 80 cc 85 cc	16 cc 20 cc 22 cc 40 cc 50 cc 60 cc 80 cc 85 cc

Larger sizes available for the 6.00" flange size, contact SVT Associates for details.

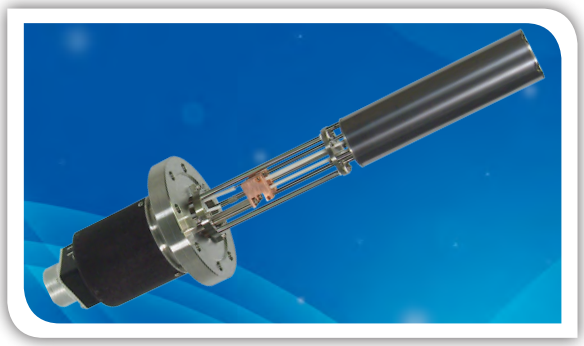


Schematic drawing of Cold-Lip Effusion Cells

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

High Temperature Effusion Cell – HT Series

Engines for Thin Film Innovation



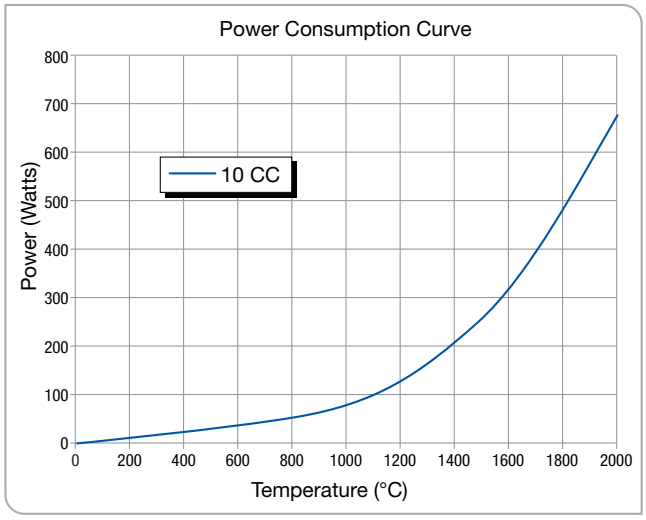
Description

SVT Associates' HT Series is the definitive choice for low vapor pressure materials. The source is designed to operate in an UHV environment at temperatures up to 1,800 °C. Models are available for mounting on a 4.50" CF flange. SVT Associates' high temperature effusion cells are thoroughly tested and characterized before shipment. Water cooling shrouds and integral shutters are optional for 4.50" CF flange or larger.

Features

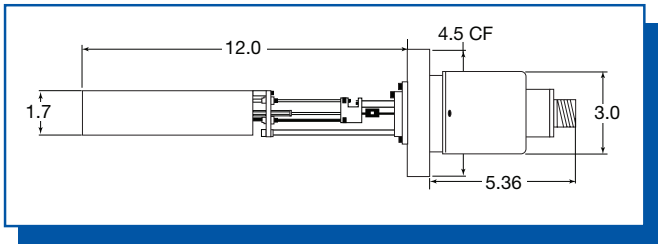
- Designed for Optimal Performance up to 1,800 °C
- Stable Fluxes for Low Vapor Pressure Materials
- Wide Range of Sizes and Crucibles Available

Specifications	
Temperature Range	0 °C – 1,800 °C 2,000 °C Model Available
Power Requirement	1kW
Temperature Stability	+/- 0.1 °C
Temperature Reproducibility	+/- 0.1 °C
Thermocouple Type	Type C (Type D Available)
Crucible Size*	10 cc Tapered 16 cc Tapered
Standard Length*	12.0"
Materials*	PBN and Aluminum Oxide
Mounting Flange	4.50" OD – CF
Electrical Connectors	Filament: Amphenol Circular Thermocouples: Omega-Sub-Miniature
*Other sizes, materials, and lengths are available, contact SVT Associates for details.	



Typical power consumption of the10 cc High Temperature Cell.

SVTA-HT-(Crucible Size)-(Flange Size)	
Flange Size	4.50"
Crucible Size	10 cc 16 cc

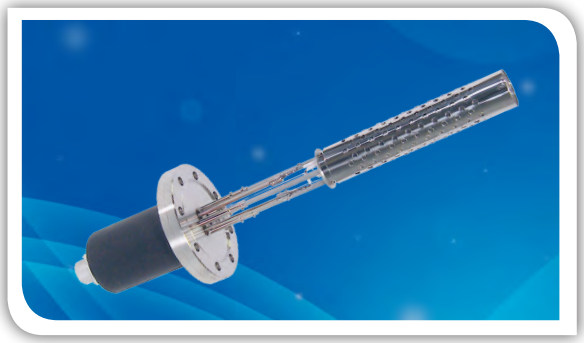


Schematic drawing of High Temperature Effusion Cells. Dimensions are given in inches.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Low Temperature Effusion Cell – LT Series

Engines for Thin Film Innovation

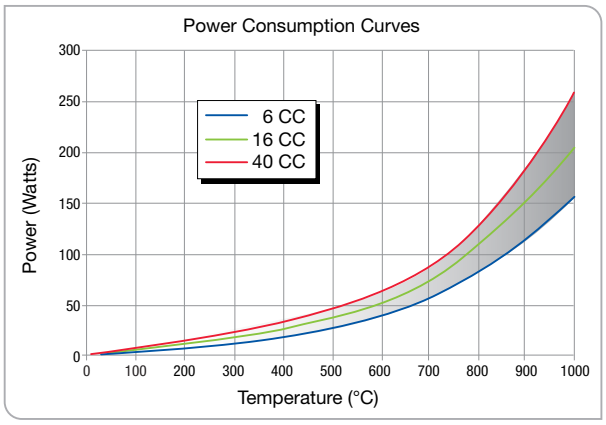


Description

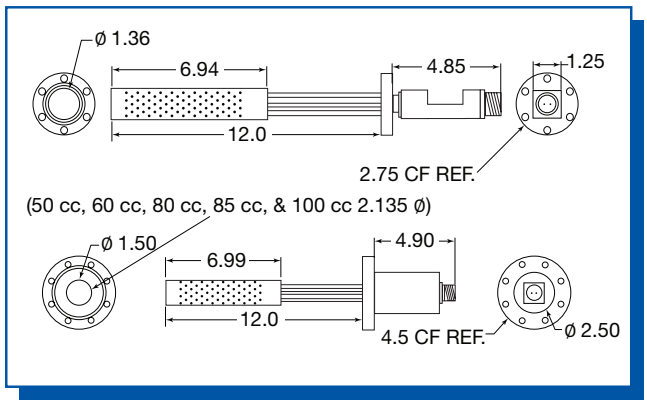
SVT Associates' LT Series is the definitive choice for high vapor pressure materials. The source is designed for temperature stability at low temperatures and utilizes a hot-lip style filament to prevent condensation due to radiative heat loss. Models are available for mounting on a 2.75" or larger CF flange. All effusion cells are thoroughly tested and characterized before shipment.

Features

- Stable Fluxes for High Vapor Pressure Materials
- Designed for Optimal Performance at Lower Temperatures
- Hot-Lip Style Filament Design to Prevent Condensation
- Wide Range of Sizes Available



Typical power consumption of 6 cc – 40 cc Low Temperature Cells.



Schematic drawing of Low Temperature Effusion Cells.
Dimensions are given in Inches.

Specifications

Temperature Range	0 °C – 1,000 °C
Power Requirement	600 W or 1kW
Temperature Stability	+/- 0.1 °C
Temperature Reproducibility	+/- 0.1 °C
Thermocouple Type	Type K
Crucible Size*	16 cc, 20 cc, 22 cc, 40 cc, 50 cc, 60 cc, 80 cc, and 100 cc. Crucibles have tapered wall for best uniformity.
Standard Length*	12.0"
Materials*	PBN and Aluminum Oxide
Mounting Flange	2.75", 4.50", or 6.00" OD – CF
Electrical Connectors	Filament: Amphenol Circular T/C: Omega Submini

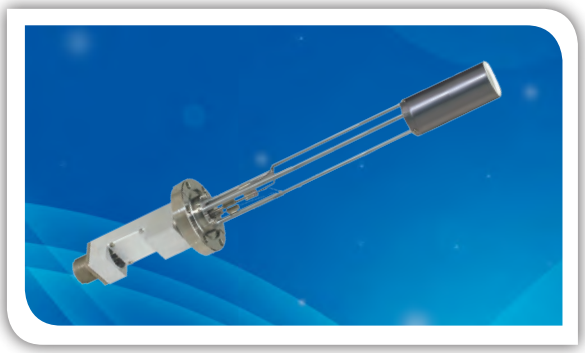
*Other sizes, materials, and lengths are available, contact SVT Associates for details.

SVTA-LT-(Crucible Size)-(Flange Size)			
Flange Size	2.75"	4.50"	6.00"
Crucible Size	16 cc 20 cc 22 cc 40 cc	16 cc 20 cc 22 cc 40 cc 50 cc 60 cc 80 cc 85 cc 100 cc	16 cc 20 cc 22 cc 40 cc 50 cc 60 cc 80 cc 85 cc 100 cc

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Dopant Effusion Cell – D Series

Engines for Thin Film Innovation

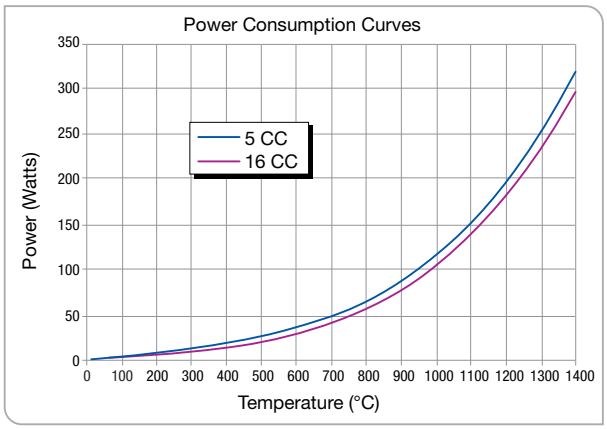


Description

SVT Associates' D Series is designed to evaporate a smaller quantity of materials, such as Silicon and Beryllium. Models are available for mounting on either a 2.75" or 4.50" OD CF. All cells are thoroughly tested and characterized before shipment. Water cooling shroud and integral shutter are optional for 4.50" CF flange or larger. Because of its small size it is ideally suited for dopant applications.

Features

- Excellent Choice for Dopant Applications
- Provides Excellent Incorporation
- Integral Cooling Shroud and Shutter



Typical power consumption of 5 cc – 16 cc Dopant Effusion Cells.

SVTA-D-(Crucible Size)-(Flange Size)		
Flange Size	2.75"	4.50"
Crucible Size	5 cc 6 cc	5 cc 6 cc 16 cc

Specifications	
Temperature Range	0 °C – 1,400 °C
Power Requirement	600 W or 1 kW
Temperature Stability	+1/- 0.1 °C
Temperature Reproducibility	+1/- 0.1 °C
Thermocouple Type	Type C (Type D Available)
Crucible Size*	5 cc, 6 cc, 16 cc Crucibles have tapered wall for best coverage.
Standard Length*	12.0"
Materials*	PBN and Aluminum Oxide
Mounting Flange	2.75" or 4.50" OD – CF
Electrical Connectors	Filament: Amphenol Circular TIC: Omega Submini

*Other sizes, materials, and lengths are available, contact SVT Associates for details.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

EXCEL Series Effusion Cells

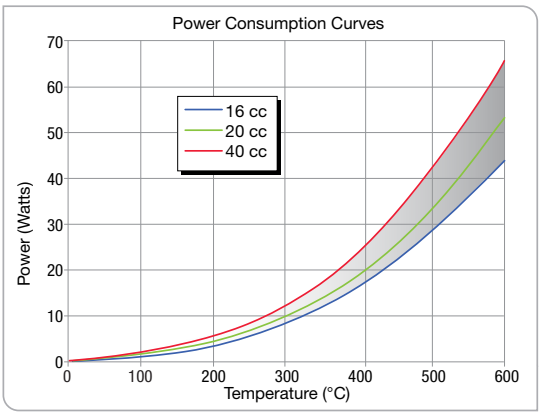
Engines for Thin Film Innovation

Description

SVT Associates' EXCEL Series is designed to work in a High Vacuum (HV) or Ultra High Vacuum (UHV) deposition system. It is the perfect choice for use in deposition of organic compounds or very high vapor pressure materials. All sources are rated for a maximum operating temperature of 600 °C. Each source comes standard with a "Hot-Lip" style filament to prevent material build-up at the lip of the crucible during evaporation. All sources use a type K thermocouple. Integral shutters and a cooling shroud are available for 4.5" CF or larger flanges.

Features

- Designed for Organic Compounds or Very High Vapor Pressure Materials
- "Hot-Lip" Style Filament Design
- A Variety of Flange Sizes Available



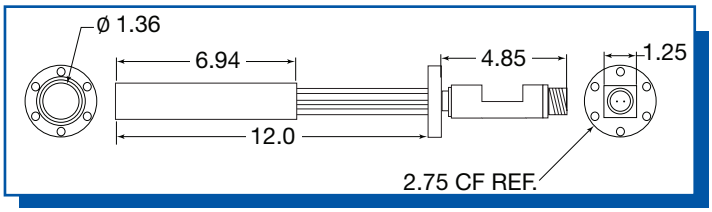
Typical power consumption of 16 cc – 40 cc EXCEL Effusion Cell.

Specifications	
Temperature Range	0 °C – 600 °C
Power Requirement	600 W or 1kW
Temperature Stability	+/- 0.1 °C
Temperature Reproducibility	+/- 0.1 °C
Thermocouple Type	Type K
Filament Style	Tantalum "Bird Cage" with Non-Conductive Guides
Crucible Size*	16 cc, 20 cc, 22 cc, 40 cc, 50 cc, 60 cc, 150 cc Crucibles have tapered wall for best coverage.
Materials*	PBN and Aluminum Oxide
Standard Length*	12.0"
Mounting Flange	2.75", 4.50" or 6.0 OD – CF
Electrical Connectors	Filament: Amphenol Circular Thermocouples: Omega-Sub-Miniature

*Other sizes, materials, and lengths are available, contact SVT Associates for details.

SVTA-EXCEL-(Crucible Size)-(Flange Size)			
Flange Size	2.75"	4.50"	6.00"
Crucible Size	16 cc 20 cc 22 cc 40 cc	16 cc 20 cc 22 cc 40 cc 50 cc 60 cc	150 cc

Larger sizes available for the 6.00" flange size, contact SVT Associates for details.



Schematic drawing of EXCEL source for a 2.75" CF mounting. Dimensions are given in Inches.

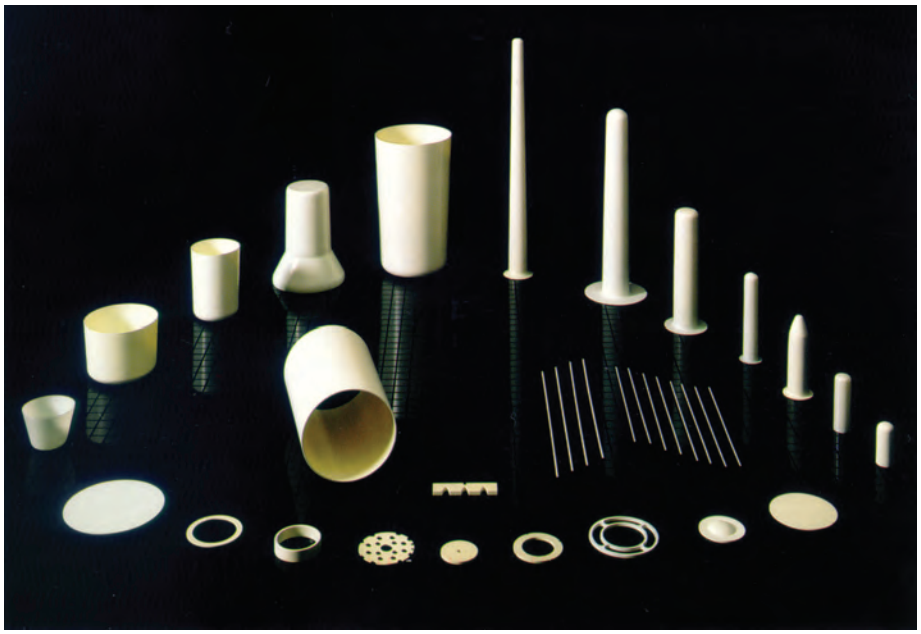
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Effusion Cell Accessories

Engines for Thin Film Innovation

Crucibles

SVT Associates has a wide range of crucibles for effusion cells available. Crucibles can be tailored to fit your specific needs.



Sizes Available: 6 cc, 10 cc, 16 cc, 20 cc, 40 cc, 50 cc, 60 cc, 80 cc, and 150 cc

Materials Available: PBN, Pyrolytic Graphite, Tungsten, Beryllium Oxide, Alumina, Quartz, and Tantalium

Note: Not all sizes are available in all materials. Contact SVT Associates for size and material options or for any custom sizes.

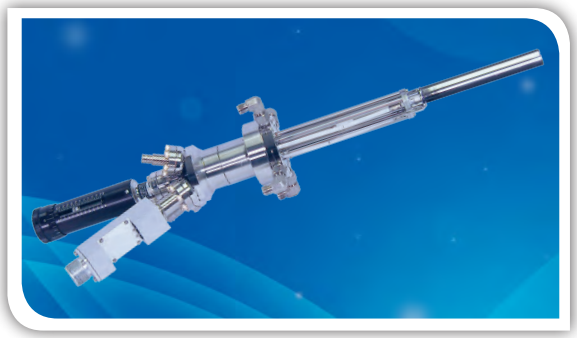
Controller Packages

Model	Description
SVTA-PS-1	Power Supply 1kW
SVTA-PS-3	Power Supply 600 W
SVTA-EC-C25	25' Effusion Cell Cable
SVTA-EC-C25B	Bakeable 25' Effusion Cell Cable
SVTA-TC-1	Temperature Controller

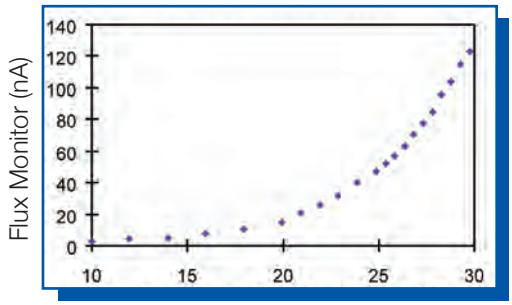
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SVTA-EBS Compact E-Beam

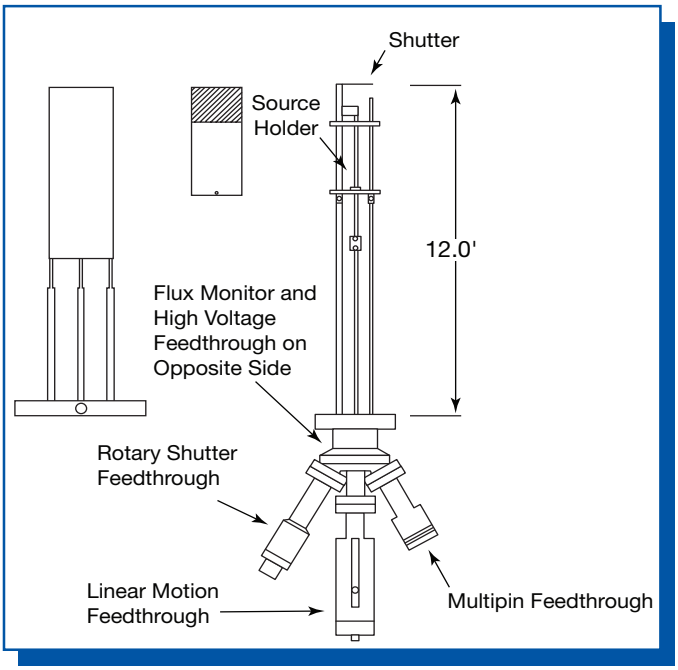
Engines for Thin Film Innovation



Silicon Flux vs. Emission at 1.5 keV



Flux Monitor current as a function of emission current between tip and filament for a silicon rod



Schematic drawing of a compact electron beam source showing linear motion feedthrough.

Description

SVTA-EBS Compact evaporator is a very versatile source for depositing thin layers of Carbon, Silicon, Tantalum, Molybdenum, and most other refractory metals that are manufactured in wire form. Its exclusive design utilizes an electron beam power supply for electron emission and an integral flux monitor to regulate the deposition rate. The source material is typically a rod of 1-5 mm in diameter. When held at a positive potential, it attracts electrons emitting from the filament and is heated to an evaporation temperature to produce a flux of atoms. A linear motion feed-through provides adjustment of the source position. Alternatively, materials in chunk or powder form may be evaporated from a special crucible.

Typical Applications

- Silicon MBE – Metallization
- Magnetic Thin Films
- Doping
- Interface Studies

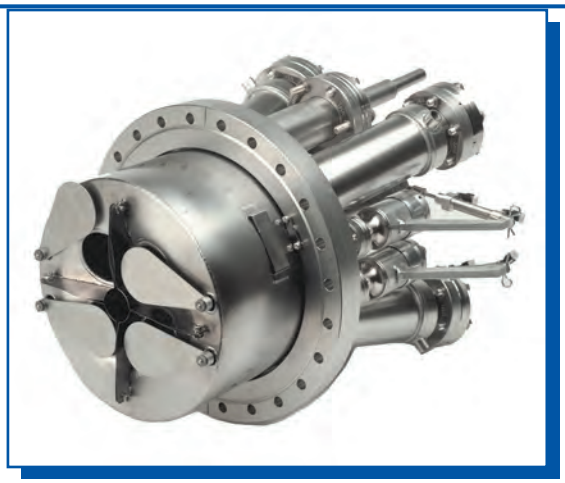
Specifications	
Maximum Power	300 W
Emission Current	100 mA
Maximum Temperature	3,000 °C
Electrical Connectors	Filaments: Amphenol Circular High Voltage: SHV
Mounting Flange	2.75" or 4.5" CFF
Length	12” (or Custom)

Model	E-Beam Source
SVTA-EBS-275	12" Standard Compact Electron Beam
Model	**Additional Options**
SVTA-EBS-LF2	2" Linear Feed
SVTA-EBS-WCS	Water Cooling Shroud
SVTA-EBS-IS	Integral Shutter
SVTA-EBS-CR	Crucible Option

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SVT Associates' Source Flanges

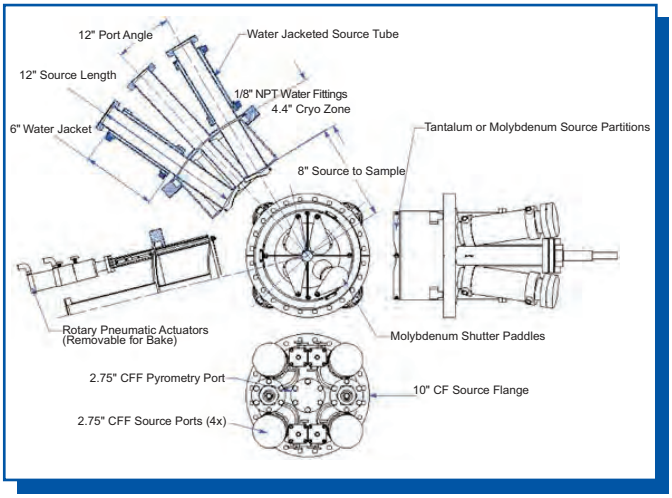
Engines for Thin Film Innovation



Font view of a 10" OD source flange with four effusion cell ports.

Description

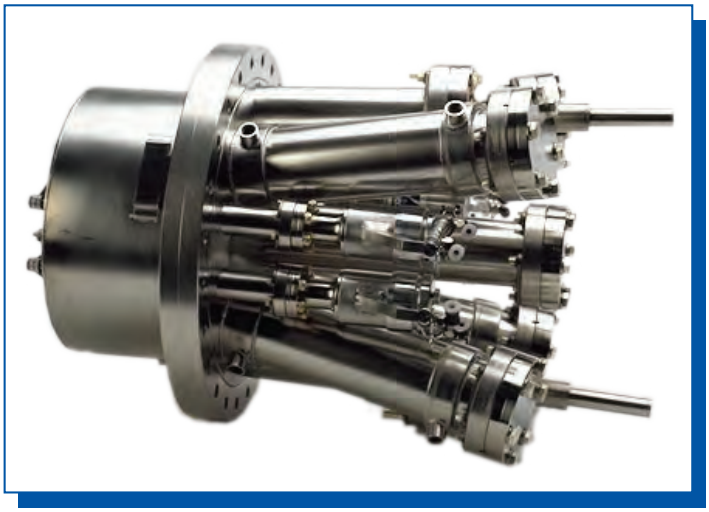
SVT Associates' Source Flanges are designed in a wide range of sizes to meet your thin film deposition needs. SVT Associates offers sizes that range from four – 2.75" effusion cell ports on a 10" flange, to eight – 4.625" effusion cell ports on a 22" flange. Each source flange contains an attached cryopanel with large LN_2 or H_20 feedthrough. The source flange also includes a center viewing port for pyrometry and can be ordered with or without integral shutter assemblies.



A typical source flange configuration for four 2.75" CF port on a 10" CF with integral shutters. Compatible with an extensive line of SVT Associates' effusion cells to grow many types of epitaxy films.

Features

- A Wide Range of Sizes Available
- Extensive Line of Matching Effusion Cells
- Optional Pyrometry Port and Integral Shutter



Side view showing rotary pneumatic cell shutters.

The following information is needed when ordering a source flange. Please contact SVT Associates for more information.

1. Maximum O.D. of Source Flange
2. Number of Effusion Cells and Sizes
3. Source to Substrate Distance
4. Shutters and View port Requirement
5. Cooling Shroud (LN_2 or H_20)

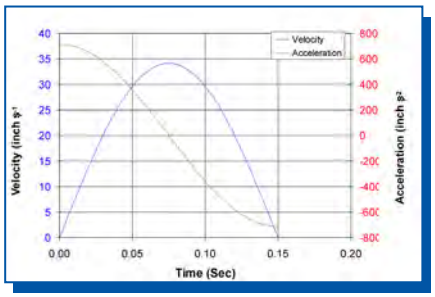
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Shutters and Controllers

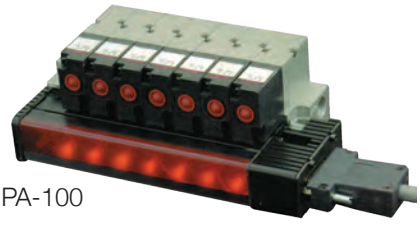
Engines for Thin Film Innovation

Description

SVT Associates' Linear Magnetically Coupled Shutter is installed on a 4½" CFF or 5" X 2" Rectangular Flange. The Linear Pneumatic Shutter is mounted on a 4½" CFF. The Rotary Bellow Coupled Shutter is mounted on a 1⅓" CFF source port. Please contact an SVT Associates Sales Representative for additional details. Custom Flange sizes are available.

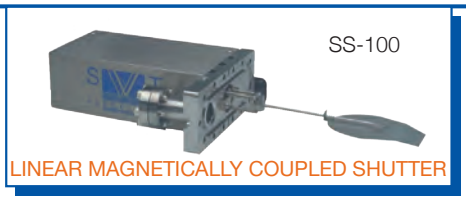


- <150 msec Open/Close Actuation at 3"
- Soft Action – Minimizing Mechanical Shock
- Pneumatically Actuated – Requires only 10-15 psi
- 3" Standard Stroke – Can be Adapted for Many Different Lengths
- Linear Magnetically Coupled
  - Eliminates Need for Bellows
  - Increases Lifetime
  - Lowers Particle and Outgassing Levels
- Refractory Metal Blades and Shafts in "Hot" Area of stroke



PA-100

- Modular Design Allows Exact Number of Solenoids Needed
- Pressure Regulation at Manifold For Convenient Operation



SS-100

LINEAR MAGNETICALLY COUPLED SHUTTER

LPS-100

PNEUMATIC LINEAR SHUTTER

SVT Associates' SC-100 and SC-200 controls up to 12 Shutters through the front panel switches with integral output to pneumatic valve manifold. The SC-100 is manually controlled and SC-200 is an automatic computer programmable shutter controller.

RS-100

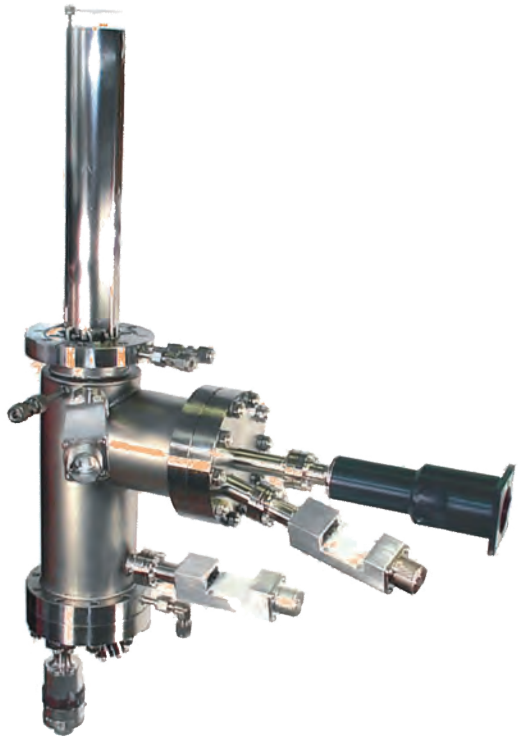
ROTARY BELLOW COUPLED SHUTTER

Shutter Controller Specifications	
Power	100-240 VAC 1A 50/60 Hz
Main Fuse	2A Slow Blow Fuse – Type 313
Physical Dimensions	3U (5¼") Tall 19" Rack Mountable Enclosure 19" x 12" x 5¼" (49 cm x 31 cm x 14 cm)
SC-200 SPECIFICATIONS	
SC-200 Control Output	4, 8, or 12 Channels 24 VDC – 0.2A per Channel 25 Pin Female D-Sub Connector
TTL Output (Optional)	15 Pin Female D-Sub Connector
Digital Communications	RS-232 or RS-485 9 Pin D-Sub Connector
Weight	10 lbs (4.5g)
SC-100 SPECIFICATIONS	
SC-100 Control Output	12 Channels – 24VDC 0.2A per Channel Channels 9-12 have Optional Interlock Control 25 Pin Female D-Sub Connector
Remote Control Interface	Individual Channels can be configured to be controlled by a user supplied external switch
Weight	6 lbs (2.7kg)

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SSA Pro 100/150-25

Engines for Thin Film Innovation

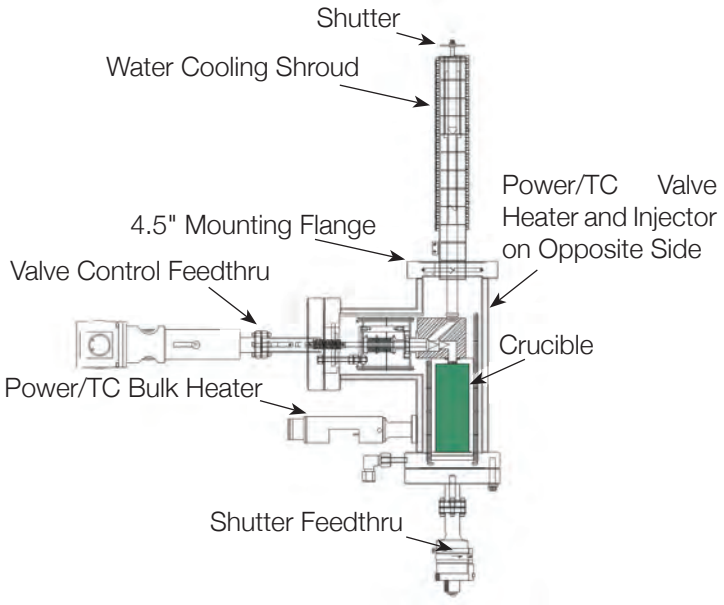


Description

Valved Source for Full Panel OLED Manufacturing

Features

- High Deposition Uniformity (+/- 1.5% over 100 mm^2 at 150 mm)
- Crucible Capacity 25 – 100 cc
- High FluxStability (+/- 1%)
- Fast Flux Control (250ms)
- Fast Shutter Action (<0.5s)
- >10A/s Flux Rate at 150 mm (NPB @ 315 °C)



7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

SSA Pro 250/200-10

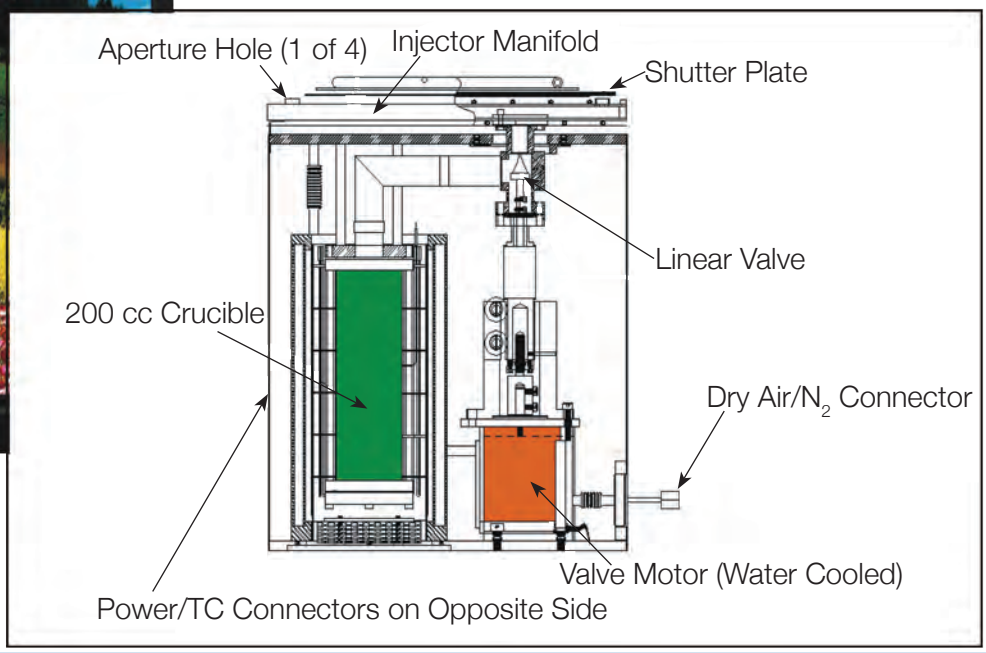
Engines for Thin Film Innovation

Description

Valved Source for Full Panel OLED Manufacturing

Features

- High Deposition Uniformity (+/- 3% over 250 mm^2 at 200 mm)
- Crucible Capacity 10–100 cc
- High FluxStability (+/- 1%)
- Fast Flux Control (250 ms)
- Fast Shutter Action (<0.5s)
- >10A/s Flux Rate at 200 mm (Alq3 @ 340 °C, NPB @ 305 °C
- Low Substrate Temperature (<40 °C)



SVT MBE

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Production Thermal Sources
Controllable Large Scale Evaporation

Engines for Thin Film Innovation

SVTA-DF-800-1000

1,000 cc Production Thermal Source

Description

SVT Associates offers a wide range of thermal sources to evaporate almost any material. By utilizing more than 15 years of experience providing equipment for MBE applications, SVT Associates' thermal sources are engineered to provide thermal stability and control. The large variety of shapes, sizes, and optimum temperature ranges ensure that SVT Associates has the correct source for your thin film solar cell or OLED application.

Each Thermal Source is manufactured of high purity materials that are carefully selected to ensure material compatibility as well as maintaining an uncontaminated growth environment. Each Thermal Source is thoroughly tested and certified prior to delivery to guarantee the highest performance. SVT Associates' Thermal Sources encompass capacity, controllability, and stability needed for the next generation solar cell and OLED panels.

Features

- High Thermal Stability Enables High Efficiency Thin Film Solar Cell and OLED Deposition
- Large Capacity for Extended Growth Campaigns
- Wide Temperature Ranges Allow Controlled Evaporation of Most Materials
- High Purity Construction Eliminates Contamination
- Large Variety of Crucible Shapes for Optimized Flux Profile

SVTA-V-450-80

The Viking Dual Filament Thermal Source with the proprietary shaped crucible delivers large capacity while maintaining controllable and uniform deposition.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

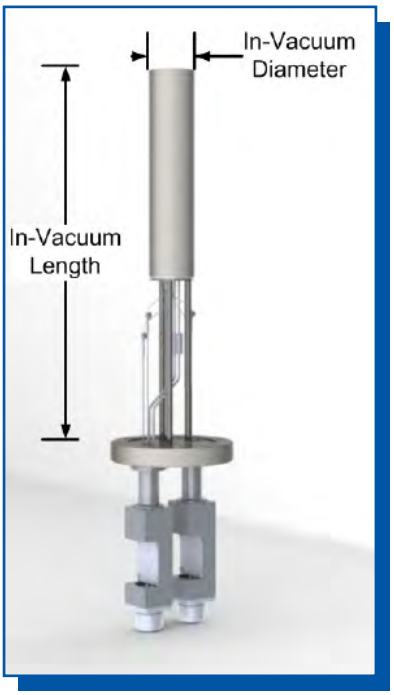
Production Thermal Sources
Specifications

Engines for Thin Film Innovation

Production Thermal Sources Selection Guide

Model	Optimum Temperature Range	Sizes Available
SVTA-DF – Dual Filament Thermal Source	600 °C to 1,600 °C	85 cc, 150 cc, 500 cc, 1,000 cc
SVTA-LTDF – Low Temperature Dual Filament Thermal Source	400 °C to 1,000 °C	85 cc, 150 cc, 500 cc, 1,000 cc
SVTA-V – Viking Thermal Source (For Indium and Gallium)	800 °C to 1,400 °C	60 cc, 80 cc, 150 cc, 500 cc
SVTA-EXCEL – Excel Thermal Source (For Organic Materials)	100 °C to 600 °C	85 cc, 150 cc, 500 cc, 1,000 cc

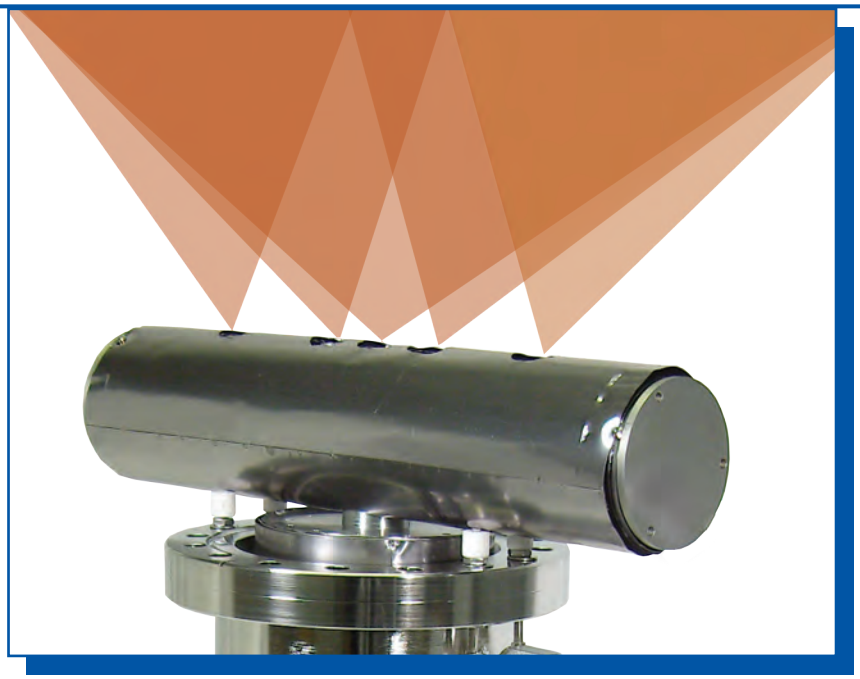
Specifications	
Source Temperature Stability	± 0.1 °C
Temperature Reproducibility	± 0.1 °C
Mounting Flange	Capacity: 4.5" (DN63) CF Flange – 60 cc, 80 cc, and 85 cc Capacity: 6.0" (DN100) CF Flange – 150 cc and 500 cc Capacity: 8.0" (DN150) CF Flange – 1,000 cc
In-Vacuum Length	12" (305 mm) Standard 10" (254 mm) to 14" (355 mm) Upon Request
In-Vacuum Diameter	60 cc: 2.135" (54 mm) 80 cc: 2.100" (53 mm) 85 cc: 2.290" (58 mm) 150 cc: 2.630" (67 mm) 500 cc: 3.540" (90 mm) 1,000 cc: 5.500" (140 mm)
Thermocouple Type	< 1000 °C Maximum: Type K > 1000 °C Maximum: Type C
Electrical Connections	Atmosphere Side Filaments: Amphenol Circular T/Cs: Omega Subminiature
Bake Temperature	200 °C
Options Available	Integrated Shutter and Water Cooling



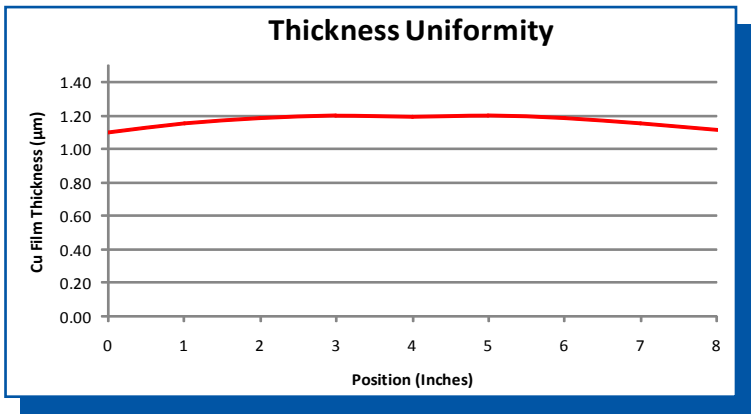
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Linear Evaporation Sources
In-Line and Roll to Roll Deposition

Engines for Thin Film Innovation



SVTA-300-LES: 300 mm Linear Evaporation Source with Simulated Cu Flux Distribution.



Uniformity data acquired for 200 mm wide sample at 200 mm source to sample distance.

Description

SVT Associates' Linear Evaporation Sources are engineered for in-line and roll to roll processing for thin film solar cells or OLED manufacturing. Based on more than 15 years of effusion cell technology, the Linear Evaporation Source produces controllable deposition on wide area substrates.

The Linear Evaporation Sources are comprised of a bulk evaporator that is capable of temperatures greater than 1,500 °C and a linear distribution manifold that uniformly deposits material across the full length of the substrate. The innovative manifold design eliminates spitting of materials and prevents material defects. Changeable apertures are incorporated in the manifold that can rapidly be changed to optimize the flux profile.

The independently controlled heated regions allow the user to fine tune the deposition process. An optional shutter can be integrated to the source for complete deposition control.

Features

- Distribution Manifold Provides Uniform Deposition Across a Large Moving Substrate
- Independent Thermal Zones for Precision Control
- Changeable Distribution Nozzles for Tailored Flux Profile
- Large Capacity Models for Long Growth Campaigns
- High Temperature Design Provides High Growth Rates

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Linear Evaporation Sources
Specifications

Engines for Thin Film Innovation

Linear Evaporation Source Selection Guide

Model	Deposition Width	Compatible Materials	Mounting Flange
SVTA-LES-300	300 mm	500 cc	6" (DN100) CF Flange Other Configurations on Request
SVTA-LES-600	600 mm	1,000 cc, 2,000 cc or 5,000 cc	10" (DN200) CF Flange Other Configurations on Request
SVTA-LES-1200	1,200 mm	2,000 cc or 5,000 cc	10" (DN200) CF Flange Other Configurations on Request

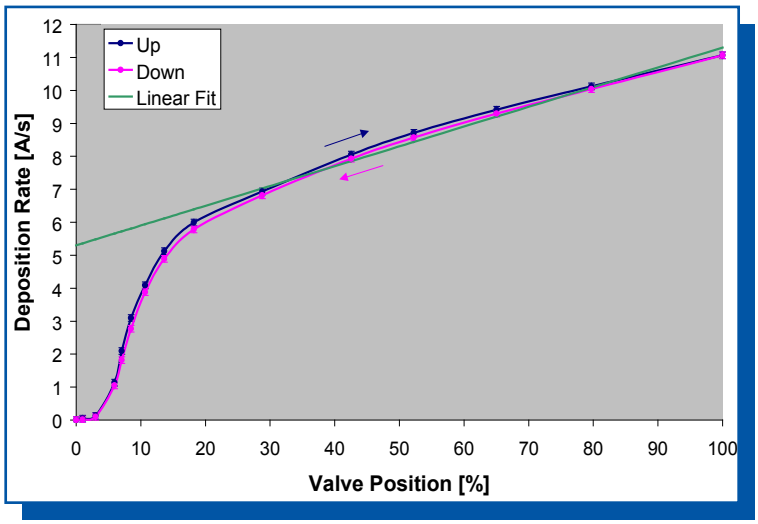
Performance Specifications	
Maximum Bulk Evaporator Temperature	1,500 °C
Maximum Distribution Manifold Temperature	1,600 °C
Temperature Stability	± 0.1 °C
Typical Flux Stability	< 1%
Maximum Operating Pressure	5 x10^{-5} torr
Deposition Uniformity	± 4% at 300 mm Source to Substrate Distance
Bake Temperature	200 °C
Thermocouples	Type C Type K Available on Request
Cool Down Time	< 120 Minutes
Electrical Connectors	Atmosphere Side Filaments: Amphenol Circular T/Cs: Omega Subminiature
Cooling Water Connections	2 x ¼" VCR (Outlet and Inlet)
Maximum Water Pressure	80 psi
Water Flow Rate	500 ml/min

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Valved Sources
Precision Control for High Vapor Pressure Materials

Engines for Thin Film Innovation

SVTA-C-SE-30000: 30 L Valved Selenium Source



The proprietary valve design provides smooth and reproducible flux ramping. Data taken from SVTA-C-SE-200 source.

Description

SVT Associates' Valved Deposition Source provides precision flux control of high vapor pressure materials. Incorporating a proprietary valve design, the Valved Deposition Sources offer reproducible growth and instantaneous flux response. An optional motorized valve provides automated process control.

The Valved Deposition Source coupled with the optional flux distribution manifold provides uniform deposition on large area substrates. Ideal for in-line processing such as thin film solar cell and OLED manufacturing, the distribution manifold utilizes the SVT Associates' changeable aperture design for fine tuning of the flux profile. The distribution manifold increases material incorporation by directing all of the flux onto the substrate as well as can be placed within close proximity of the sample for increased growth rate.

An optional thermal excitation region can be incorporated in the Valved Deposition Source to increase the reactivity of large polyatomic molecules. The thermally excited molecules decrease material consumption and improve material quality for materials incorporating sulfur and selenium.

Features

- Needle Valve Design for Precision Flux Control of High Vapor Pressure Materials
- Optional Thermal Excitation Zone Increases Material Incorporation
- Customizable Flux Distribution Manifold Available
- Large Capacity Models for Extended Growth Campaigns
- Optimized for Large Sample Thin Film Solar Cell and OLED Applications

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Valved Sources
Specifications

Available Models

Model	Capacity	Compatible Materials
SVTA-VC-200	200 cc	As, Sb, Se, Te, S
SVTA-VC-500	500 cc	As, Sb, Se, Te, S
SVTA-C-15000	15,000 cc	Se, Te, S
SVTA-C-30000	30,000 cc	Se, Te, S

Performance Specifications	
Feedthrough Flange	4.5" (DN63) CF Flange Other Configurations on Request
Maximum Bulk Evaporator Temperature	450 °C, 500 °C outgassing
Maximum Manifold Temperature	700 °C, 900 °C outgassing
Source Temperature Stability	± 0.1 °C
Thermocouple Type	Type K
Electrical Connectors	Atmosphere Side Filaments: Amphenol Circular T/Cs: Omega Subminiature
Bake Temperature	200 °C
Maximum Operating Pressure	$1x10^{-4}$ Torr
Deposition Uniformity	(@300 mm) ± 4%
Deposition Uniformity	(@200 mm) ± 6%
Flux Stability	1%, with integral flux sensor
Heat-Up Time	(400 °C) < 60 min
Cool-Down Time	(100 °C) < 120 min

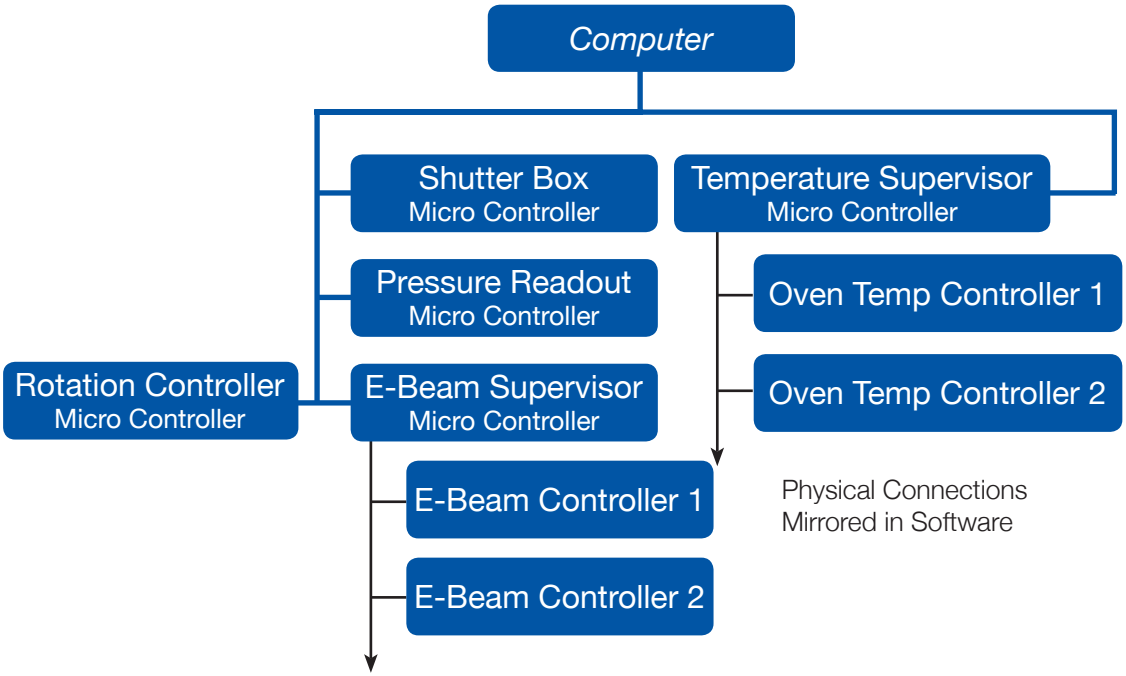
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

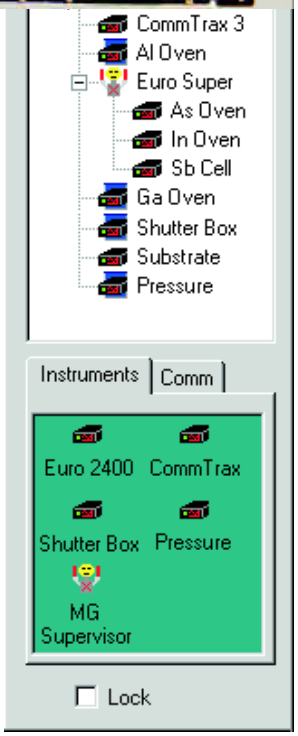
RoboMBE™
MBE Automation Software

Engines for Thin Film Innovation

Features

- Data Logging
- Generic Feedback Loops
- Object Oriented Design
- User Extendability
- Windows 2000/XP
- Computer Displays Mimics and Enhances Physical Displays





SVT MBE

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

RoboMBE™ Modules

Engines for Thin Film Innovation

Connection Drivers

Instrument Drivers

Base Package

- Com Ports
- Eurotherm Temp. Driver
- Shutter Box Driver
- Recipe Editors

Base Package Includes

- Connection to RS232/RS485 devices
- Eurotherm temperature drivers (up to 8)
- Shutter Box Driver (8 shutters standard)
- Recipe editing, execution and run-time modification
- Logging to text files or spreadsheets

Instrument Drivers

Coordinator/ Feedback Objects

Additional Components

- Analog Voltage Input
  - RHEED Analysis
  - Sensor Monitoring
- Video Capture
  - RHEED Analysis
  - Transfer Monitoring
- Pressure Gauges
- Leak Valves
- As/Sb Valve Control
- In-Situ 4000 Pyometry
- Sputter Guns
- Cold Cathode Gauges
- Stage Rotation
- Stage Rotation
- E-Beam
- RS232 Remote Control
- Sample Transfer
- Leak Valve Gauge Feedback
- Gas Leak Alarm Shutdown
- Stage Pyrometer Temp. Feedback
- Automatic Pumpdown
- System Shutdown Process Control

Additional Components Include

- More Connection Capabilities
- Many System Instruments
- Coordinator objects that execute system-wide recipes
- Feedback objects that close the control loop between instruments

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Sample Manipulators

Engines for Thin Film Innovation

Description

UHV compatible Growth Manipulators and Preparation Stages are available for 1" to larger than 8" samples. An optional integrated Master Shutter is available upon request. Up to three way direction motion provides flexibility. The integrated wafer clamp allows for simple sample mounting. Material specific design increases longevity in corrosive environments such as oxygen or ammonia background.

Features

- Magnetically Coupled Rotation
- High Resolution Rotation
- Oxygen Compatible Option Available
- Ammonia Compatible Option Available
- Up to 1,400 °C Substrate Temperature

Standard 3" Stage, Filament, and Integrated Shutter

X-Y TRANSLATION

- Resolution 0.001
- Repeatability 0.001
- Backlash 0
- Travel +/- 0.5"

Z TRANSLATION

- Resolution
- 1 mm or 1/32 scale
- Repeatability 1/32 or 1 mm
- Backlash 0
- Travel 4.0"

AZIMUTHAL ROTATION

- Resolution 1.25°
- Backlash < 1°
- Rotation 360° Continuous

Specifications	
Substrate Size	Up to 8"
Mounting Flange	4.5" to 10.0" CF
Temperature Range	Up to 1,400 °C
Thermocouple	Type C or K
Temperature Uniformity	+/- 1%
Filament Material	Graphite *(Others Available Upon Request)*
Azimuthal Rotation with Motor	0 – 60 rpm
Bakeout Maximum Temperature	200 °C
Power Supply	1kW up to 5kW

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Sample Manipulators

Engines for Thin Film Innovation

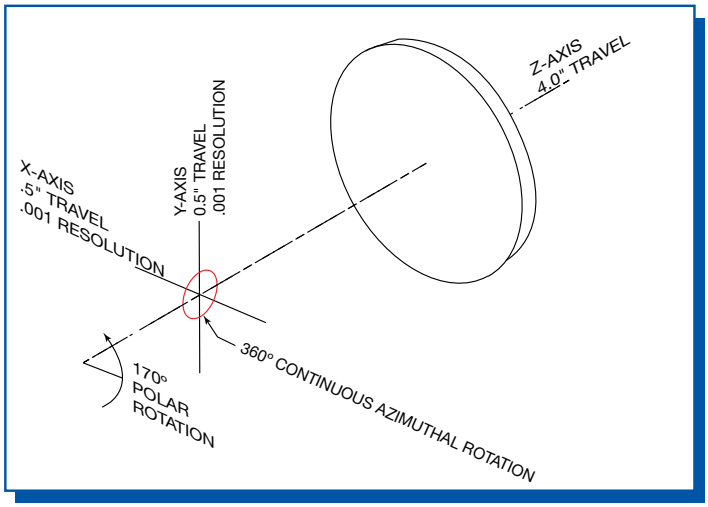
Description

UHV Sample Manipulators with polar rotation are available for sample sizes from 1" up to 3". All magnetically coupled rotations provide long service life and protects against leaks. The 170° of polar rotation allows for simple sample transfer and compatibility with multiple MBE system designs. Contact SVT Associates for details on system model compatibility.

Features

- High Resolution Rotation
- Oxygen Compatible Option Available
- Ammonia Compatible Option Available
- Up to 1,000 °C Substrate Temperature
- 170° Polar Rotation for Sample Transfer

Specifications	
Substrate Size	Up to 3"
Mounting Flange	4.5" to 10.0" CF
Temperature Range	Up to 1,000 °C
Thermocouple	Type C
Temperature Uniformity	+/- 1%
Filament Material	Graphite *(Others Available Upon Request)*
Azimuthal Rotation with Motor	0 – 15 rpm
Bakeout Maximum Temperature	200 °C
Power Supply	1kW up to 5kW
Options	Substrate Biasing Motorized Azimuthal Rotation Custom Lengths



Motion

X-Y TRANSLATION

- Resolution 0.001
- Repeatability 0.001
- Backlash 0
- Travel +/- 0.5"

Z TRANSLATION

- Resolution 1/32 or 1 mm scale
- Repeatability 1/32 or 1 mm
- Backlash 0
- Travel 4.0"

AZIMUTHAL ROTATION

- Resolution 1.25°
- Backlash < 1°
- Rotation 360° Continuous

POLAR ROTATION

- 170°

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

In-Situ Monitoring for Production MBE Processes

Engines for Thin Film Innovation

RHEED

Growth rate, surface condition, and substrate temperature calibration.

Pyrometric Interferometry (PI)

Substrate temperature, film thickness and material composition.

Atomic Absorption Densitometry (AA)

Real-time flux measurement.

Cathodoluminescence (CL)

Material composition, and impurity level for wide gap materials.

Ellipsometry

Film thickness, and material composition.

Desorption Mass Spectroscopy (DMS)

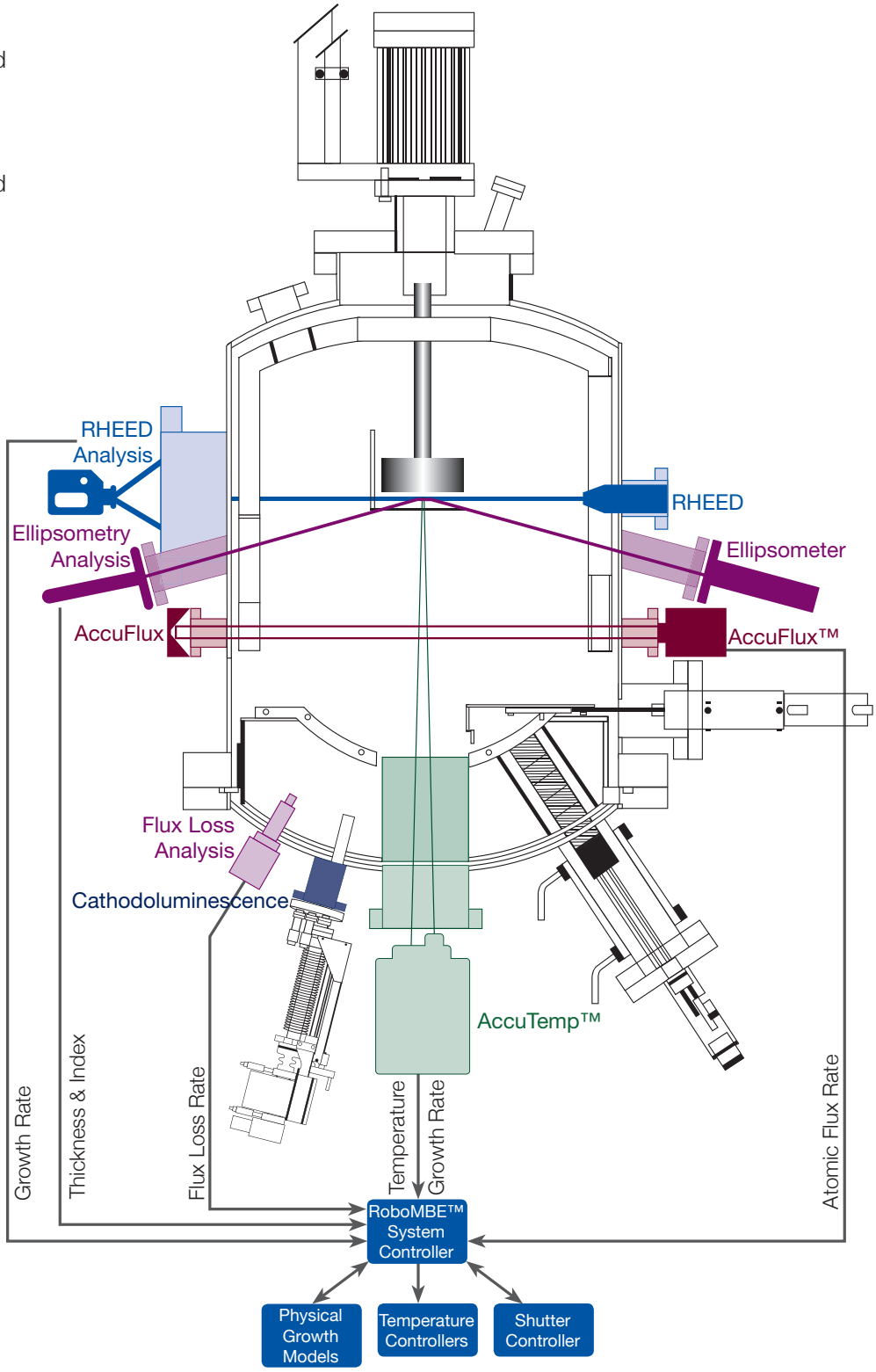
Composition control, and substrate temperature.

In-Situ X-Ray

Material Composition, lattice constant, and strain.

UV Photoelectron Emission

RHEED-like intensity oscillations.

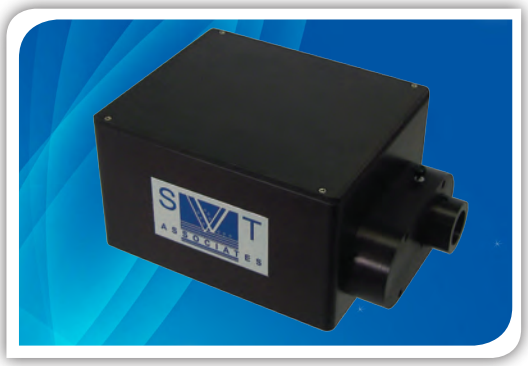


7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

AccuTemp™ Process Monitor

Real-Time Measurement of Temperature and Growth Rate

Engines for Thin Film Innovation



Specifications	
Temperature Ranges Pyrometer	450 °C – 1,300 °C
Bandgap Module	RT – 700 °C
Compatible Substrates	Si, GaAs, InP, Sapphire STO, GaSb, MCT, ect.
Radiometer Wavelengths	950, 850 nm
Temperature Equivalent Noise	< 0.5 °C @ 450 °C Si
Reflectometer Wavelengths	950, 470 nm
Reflectometer Equivalent Noise	< 1 nm @ Films > 100 nm
Target Distance Range	400 mm to infinity
Measurement Spot Size	> 7 mm Ø
Viewport	2.75" CF (4.5" CF for Bandedge Add-on)
Dimensions	100 x 140 x 130 mm
Alignment	Video Monitor
Computer Requirement	Windows XP, Serial Port Interface

Description

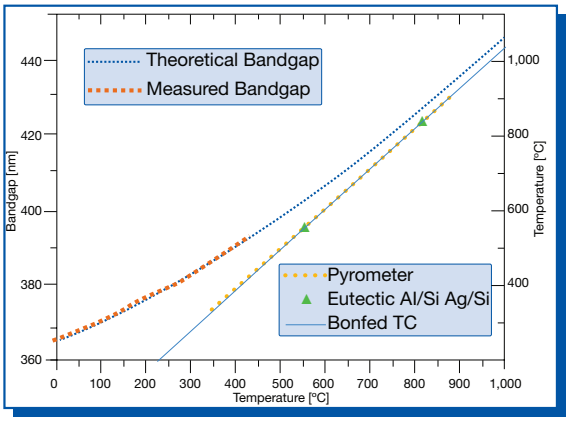
The AccuTemp (*In-Situ* 4000) process monitor is an ideal solution for closed-loop monitoring and control of multilayer thin film growth applications such as MBE, MOCVD, and CIGS. The AccuTemp system provides real-time and accurate information on the substrate temperature, film thickness, and growth rate using a single normal incidence view-port. Temperature is measured using a two color infrared pyrometer specifically designed to be insensitive to window coating and alignment errors. The radiometer compensates for changing emissivity and corrects the pyrometry measurements. An optional Bandgap Module allows for monitoring of low substrate temperatures, and easy calibration of the pyrometer. Two independent optical reflectometer signals are analyzed to provide thickness, growth rate, and refractive index in real-time.

Typical Applications

Typical application materials for the AccuTemp include, but are not limited to, GaN, GaAs, ZnO, CIGS, Si, ZnTe, SiC, MCT, and STO. The AccuTemp is used to collect temperature and growth rate data for reproducibility in the R&D setting, yet is versatile enough to be used as a monitoring and automation tool in the production environment. The Bandgap Module allows for temperature monitoring at temperatures below the range of a pyrometer such as GaAs, GaSb and Si applications.

Features

- Real-time Measurement of Temperature and Film Thickness on a Single View-port
- Dual Wavelength for Window Coating and Substrate Transparency Compensation
- Emissivity Compensation for “True” Temperature
- Closed-Loop Control of Temperature and Film Thickness
- Optional Bandgap Module for Low Temperature Measurement and Calibration

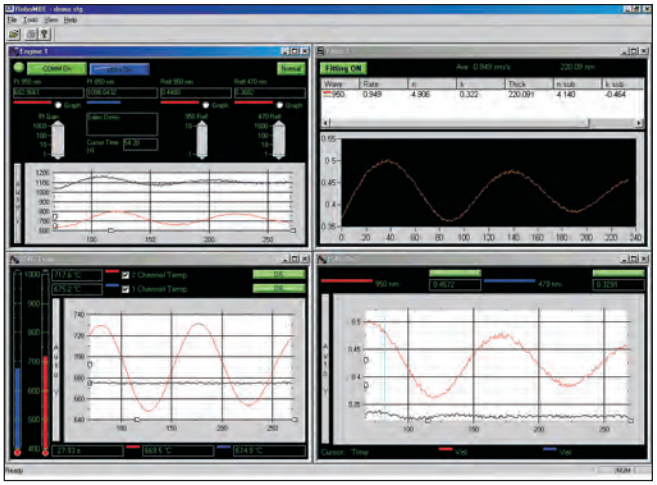


Pyrometer and bandgap module temperature data for GaN substrate.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

AccuTemp™ Process Monitor
Software Applications

Engines for Thin Film Innovation

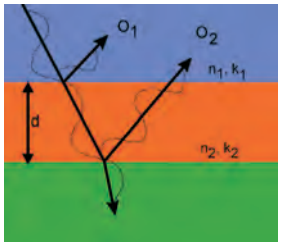


Software Description

The AccuTemp software application is fully integrated into SVT Associates' RoboMBE™ software automation and control system. The AccuTemp application performs the data acquisition from the optical head, displays the emissivity compensated temperature of the substrate in real time, and computes the specular reflectance of the substrate. The user-friendly graphical interface allows each of the measured variables to be displayed on the screen numerically, or in moving "strip charts." Collected data is stored in spreadsheet format and is compatible with most spreadsheet software for analysis. The optional Bandgap Module has an integrated reference chart to allow for a wide range of material compatibility. Tilt errors experienced during substrate rotation are easily eliminated by the built-in wobble filter.

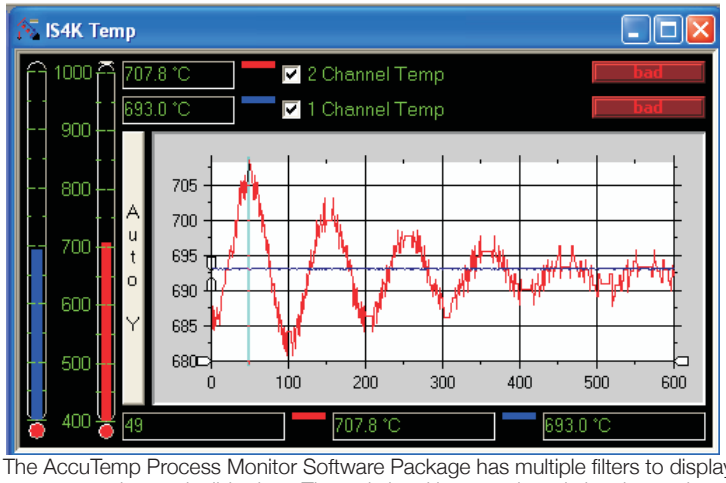
Growth Rate and Film Index Fitter

The optional Growth Rate and Film Index Fitter software module provides real-time growth rate, film thickness, and index of refraction. The period of the oscillation, amplitude, phase and damping characteristics of the reflectance data are dependent on the film's index of refraction. The growth rate fitter software processes the reflectance information and displays a current growth rate for a given film by fitting to a multi-parameter analytical model. The film index fitter allows computation of the film index of refraction. The Layer Sequencer offers a method to automate and monitor the fitting of many different successive layers such as VSCEL structures. This enables the user to develop complex layer recipes for stacks of multi-layers.

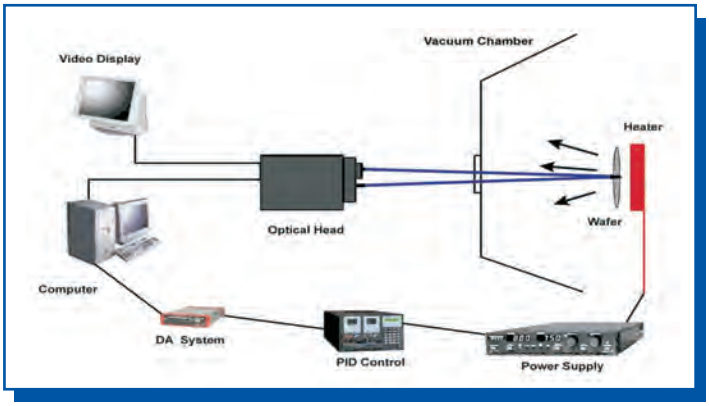


Remote Control Interface

The optional Remote Control Interface allows for the data being taken by the AccuTemp system to be used for process control functions via the RS232 link. The AccuTemp uses USB linked Data Acquisition System to allow for closed loop shutter and heater control. The Data Acquisition System can be interfaced with a PID controller for a substrate temperature control via an analog signal. The Data Acquisition can also provide control for up to four material source shutters with digital signal outputs.



The AccuTemp Process Monitor Software Package has multiple filters to display accurate and reproducible data. The red signal is an unfiltered signal from the pyrometer, while the blue signal is the emissivity corrected data.



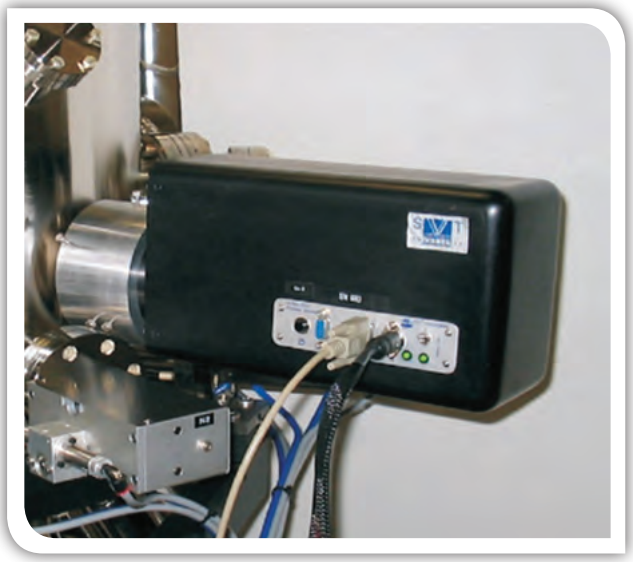
The schematic for full integration of the AccuTemp Process Monitor Remote Control Interface System.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

AccuFlux™ Process Monitor

Real-Time Flux and Composition Monitoring

Engines for Thin Film Innovation



Description

The AccuFlux Process Monitor is a non-intrusive atomic absorption based in-situ flux monitor. Using element specific lamps, the AccuFlux is designed to measure vapor flux density of both solid and gas sources. The element specific lamps allow for up to four materials to be monitored simultaneously. An innovative, proprietary optical and electronic design with on-board DSP provides sensitivity better than 0.002 nm/s. The self referencing and self aligning design provides drift free and low maintenance operation.

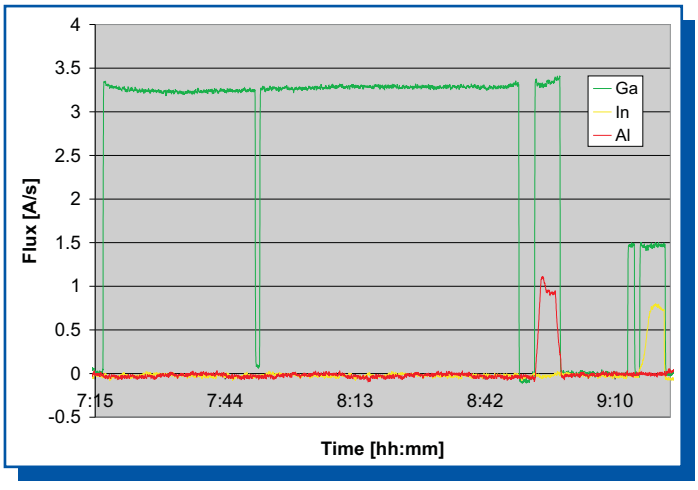
Typical Applications

The AccuFlux process monitor can be used for a wide range of materials for both MBE and MOCVD. The optional remote control package is ideal for production applications, and allows AccuFlux to provide real-time feedback for automated shutter and source control. The AccuFlux can monitor materials in multiple source configurations, including linear and confocal arrangements. The material specific light sources allow for operation in an over pressure environment such as GaAs, CIGS, and Oxide deposition.

Features

- Innovative optical design for growth rates as low as 0.002 nm/s
- High intensity, element specific light sources
- Flux monitoring of solid and gaseous sources
- Remote control option for closed-loop control
- Control up to three materials simultaneously from a single unit

Specifications	
Material System	Customer Specified
Deposition Rate Range	0.002 nm/s – 50 nm/s
Rate Equivalent Noise	0.001A/s RMS or 1% F.S.
Sampling Frequency	up to 10 Hz
Optical Path Range	25" Standard
Flange Mount	2¾" CF or Larger upon Request
Weight	6 lb (2.8kg)
Dimensions	4¾" x 12½" x 6½" (13 cm x 32 cm x 17 cm)
Light Source	Hollow Cathode Lamp Others available on Request
Wavelength Selection	Bandpass Filter (10 nm FWHM)
Computer Requirement	Windows XP
PC-Interface	RS-232

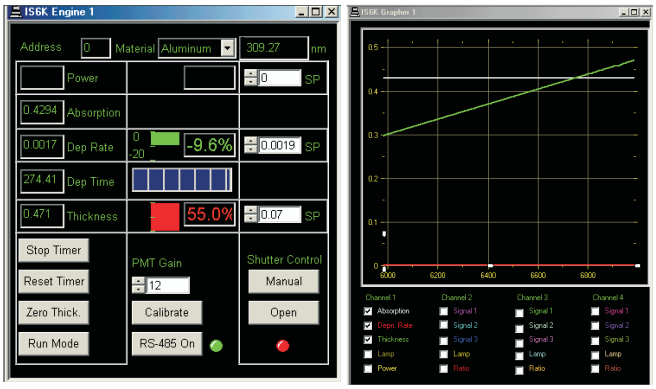


Data taken during production of a 7" x 6" HBT wafer deposition.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

AccuFlux™ Process Monitor
Software Applications

Engines for Thin Film Innovation

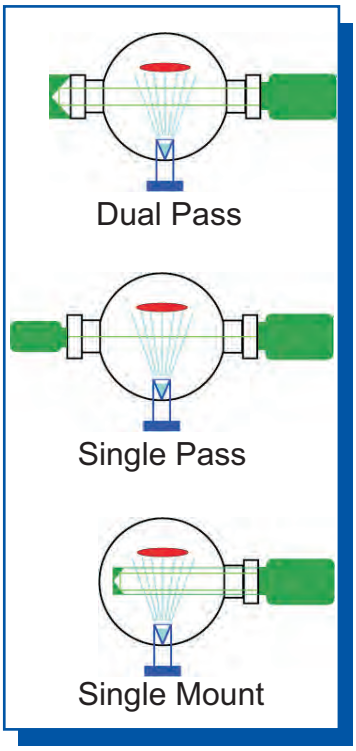


Software Description

The AccuFlux software application is fully integrated into SVT Associates' RoboMBE™ automation and control software. The AccuFlux application processes data collected by the optical head and provides realtime flux composition and growth rates. The user friendly graphical interface displays data in both a moving "strip-chart" as well as numerical values. The software is able to log data to a spreadsheet format compatible with other software platforms.

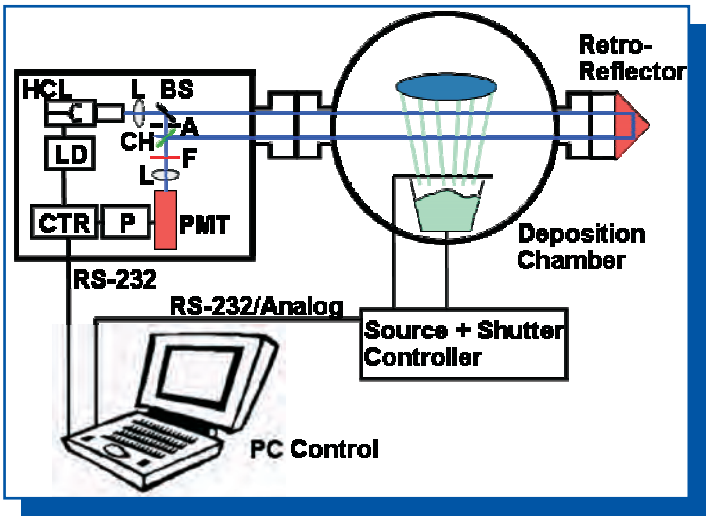
Monitor Configurations

With multiple Configurations, the AccuFlux can be incorporated into most deposition systems. The dual pass design is used for increased sensitivity. The single pass configuration is ideal for high density flux profiles. The single mount design can be integrated into deposition systems with only a single view port available.



Remote Control Interface

As an option, the Remote Control Interface allows for the data being taken by the AccuFlux system to be used for process control functions via the RS232 link. The AccuFlux uses USB linked Data Acquisition System to allow for source and shutter control. The Data Acquisition System can be interfaced with a wide array of deposition sources for MBE, CIGS, and MOCVD. As an automation tool, the Remote Control Interface can be used to increase reproducibility of the deposition process.



Schematic of the AccuFlux integrated into a typical deposition system.

Model	Description
IS6K-01	1 Material Monitoring System
IS6K-02	2 Material Monitoring System
IS6K-03	3 Material Monitoring System
IS6K-06	Remote Control Interface

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

10keV RHEED Electron Source

Engines for Thin Film Innovation

Description

Reflection High-Energy Electron Diffraction (RHEED) is an integral part of the MBE process. In thin film deposition RHEED provides important information for the user. First, its RHEED pattern conveys specific information about the surface, and second its intensity oscillation provides quantitative measures of the growth rate. RH-10 kV RHEED Electron Source is designed for operation in an UHV environment at beam voltage up to 10 kV. The 10 keV RHEED system provides a precision focus and well defined diffraction patterns with high screen intensity. The electron optics are magnetically shielded for improved operation.

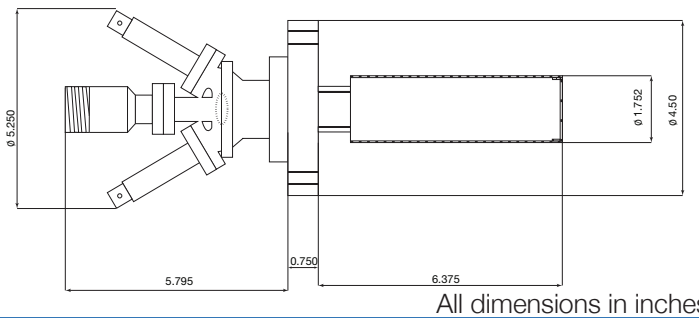
Real-time RHEED patterns are captured with the optional RHEED Image Analysis hardware and software system that gives the user the power to grow high quality thin films. A complete system includes the 10 keV RHEED Electron Source, Power Supply, and Cable Set.

Features

- Magnetically Shield Optics
- 2¾" or 4½" CFF Mounting Flange

Specifications	
Beam Voltage	10 kV
Filament Current	3:00 AM
Emission Current	5:00 AM
Mounting Flange	4½" CF
Spot Size	1.0 mm at 17"
Maximum Bake out Temperature	230 °C

Model	Description
RH-10kV	10 KeV Electron Source
RH-10VPS	Power Supply
RH-CBL	Cable Set

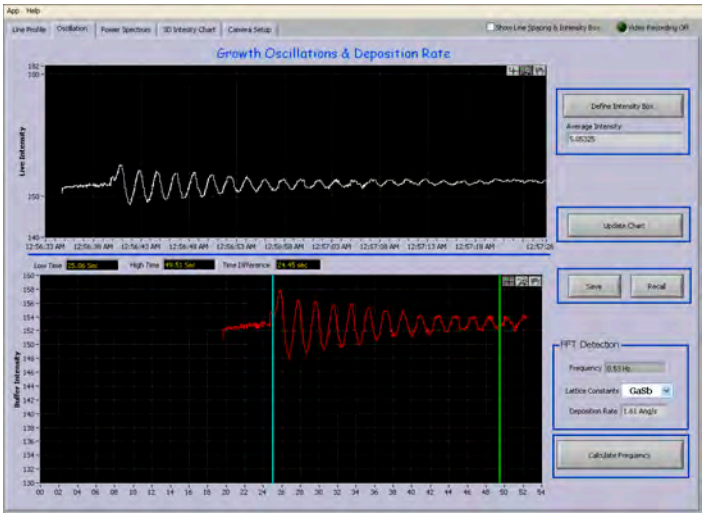


All dimensions in inches.

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

RHEED Image Analysis
Software

Engines for Thin Film Innovation



Description

RHEED (Reflection High-Energy Electron Diffraction) is an essential tool for thin film deposition processes. SVT Associates developed a state-of-the art RHEED Image Analysis Hardware/Software package that gives the user the necessary tools to gain insight into the thin film growth process and optimize material quality. The RHEED software is a multi-purpose program for analyzing RHEED patterns. The powerful software features tracking of RHEED intensity changes and measuring the rate of oscillations for quantitative determination of growth rate. It also has image analysis capabilities such as capturing and profiling.

The software program takes input from a high sensitivity CCD digital camera. All components are outside the thin film deposition system, hence retrofitting this package to existing machines is very simple.

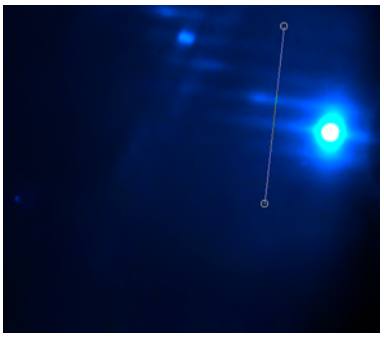
The FFT analysis of RHEED oscillations can accurately determine rates even from very noisy signals. These factors make RHEED Image Analysis an indispensable tool in the day-to-day operation of a MBE system.

Camera Specifications	
Sensitivity	QE up to 37%
Lens Focus	From 4 cm to infinity
Frame Resolution	658 w x 492 h
Color Resolution	16 bit
Refresh Rate	Up to 65 times a second
Trigger	Software, Hardware synchronization TTL
Lens Mount	CS-Mount
Electronic Shutter	Microsecond Resolution

Features

- Hi-Sensitivity Progressive Scan CCD Digital Camera
- Graphical User Interface Image and Video Capture
- Intensity Tracking and Profiling
- Real-Time Oscillation Measurement and Growth Rate
- Lattice Constant Measurement/Strain
- Substrate Rotation Triggering and E-Beam Synchronization Capabilities

⅓" CCD Color Hi-Resolution and Hi-Sensitivity Camera with 4.5", 6", or 8" CF Camera Mounting Hardware.



Profile analysis allows the user to get an intensity profile along any line drawn on the video image. It also locks onto and tracks up to eight peaks, gives peak positions or separations and can save that data in a trend file. This feature is used to measure lattice constant spacing and can be used for strain analysis.

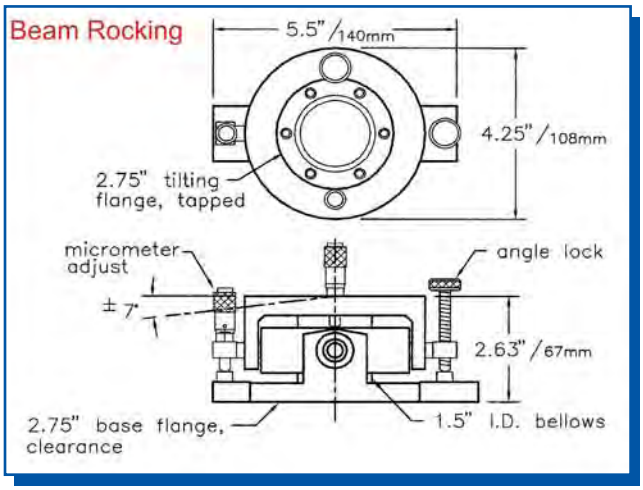
Substrate rotation and electron beam sweep triggering allows precise capturing of RHEED data for further analysis.

Model	Description
RH-IAS	Image Analysis Software
RH-CM-4.5	Camera Mount, 4.5" CFF View-Port
RH-CM-6	Camera Mount, 6" CFF View-Port
RH-CM-8	Camera Mount, 8" CFF View-Port

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

RHEED Optional Components

Engines for Thin Film Innovation



Description

RHEED screens are available in 6" or 8" CF flanges. The phosphor screens are designed to show high spatial resolution by using very fine grain powder, ensuring sharp and high brilliance diffraction patterns. The special design of the screen frame provides mounting a RHEED screen on an UHV viewport without any modifications. The RHEED screen holder is designed for easy and fast exchange of RHEED screen plates. A complete RHEED screen includes a phosphor screen with mounting hardware which fits inside a 6" or 8" view-port. Custom screens with leaded screen layers are available on request.

Phosphor Screens 6" or 8" Aluminum Frames
(Also Available in Stainless Steel Frames)

Features

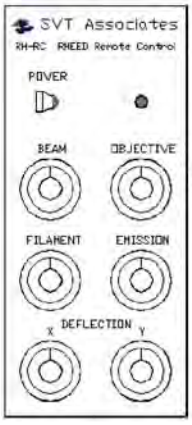
Beam Rocking (RH-BR) allows precise angle alignment and variation of the incidence angle without moving the substrate. This advanced feature is most useful for analysis performed on a fixed sample. The incidence angle can be controlled manually up to +/- 5°.

Beam Blanking (RH-BB) option controls the electron beam On and Off mode operation. The beam can be electronically switched on and off.

Differential Pumping (RH-DP) optional component designed for RHEED operation at higher pressures (10^{-4} torr range). A single differential pumping module is integrated with the RHEED electron source. Efficient pumping of the cathode section ensures long lifetime of the cathode.

Remote Control Pad (RH-RC) is designed to remote control the RHEED operation.

Model	Description
RH-RC	Remote Control Pad
RH-BB	Beam Blanking
RH-BR	Beam Rocking
RH-DP	Differential Pumping
RH-RS-6	6" RHEED Screen with Mounting Hardware
RH-RS-8	8" RHEED Screen with Mounting Hardware
RH-VPS-6	RHEED Screen Mounts in 6" Viewport
RH-VPS-8	RHEED Screen Mounts in 8" Viewport



Remote Control

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

Linear Beam Flux Monitor
LBFM Series

Engines for Thin Film Innovation

Description

SVT Associates' Linear Beam Flux Monitor utilizes a Bayard Alpert style ionization gauge for measurements in an UHV environment. The integrated bellow design allows the user to position the filament directly in front of the target to acquire accurate data for calibration of sources and growth processes. The customizable linear translation length ensures that the gauge can be retracted to ensure no interference during the deposition process. The LBFM series is ideal for high precision MBE applications.

Features

- Bayard Alpert Ionization Gauge
- Full UHV Compatible
- Bakable to 200 °C
- 2.75" or 4.5" CF Flange Mounting
- Designed for SVT Associates' MBE Systems
- Optional Gate Valve for Gauge Isolation

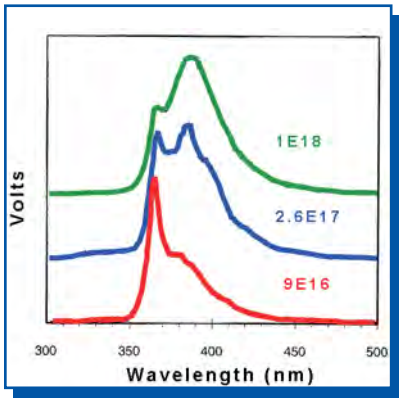
SVT Associates' LBFM Mounted on a MBE System

Specifications	
Sensitivity for N_2	25/Torr
X-Ray Limit	2 x 10^{-11} Torr
Electron Bombardment Degas	40 Watts Max.
Cathode Heating Current	2.5 to 3.5 A
Cathode Heating Voltage	3 to 5 V
Cathode Voltage Potential	+30 V (DC)
Grid Potential	+180 V (DC)
Mounting Flange	2.7" or 4.5" CF
Linear Travel	Please Specify
Recommended Controller	Granville-Phillips Model 350

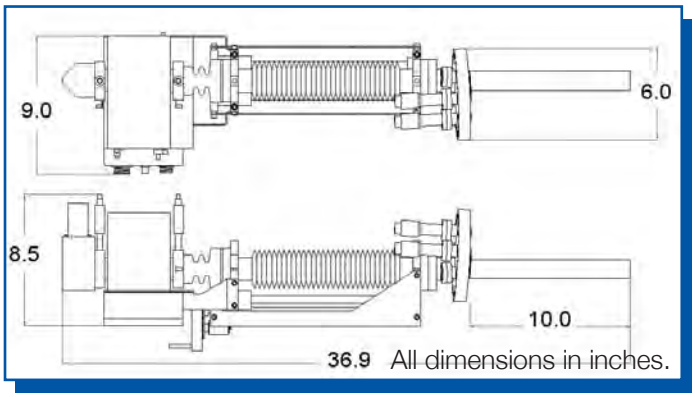
7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

In-Situ Cathodoluminescence

Engines for Thin Film Innovation



In-Situ CL Spectrum from several Mg doped p-type GaN films on sapphire. Measured hall carrier concentration is given for each curve. (Appl. Note 1101)



Description

The In-Situ CL system is an ideal solution for the monitoring of thin film growth during MBE processes. Mounted in a single viewport SVT Associates' CL system provides accurate, real-time information on substrate composition and optical quality using a standard RHEED gun (e.g. SVT Associates' RHEED Gun) in combination with a sensitive optical detection system. Retracting the system up to eight inches ensures minimum interference during growth. The electron excitation technique allows depth profiling by adjusting the electron energy. A windows based software package allows fully automated processing and analysis of the spectra.

Features

- Measurement of Film Composition and Optical Quality on a Single Viewport
- Information of Doping Levels
- Retractable System for Minimum Interference
- Description Fully Computer Controlled Acquisition and Analysis

Specifications	
Spectral Range	200 – 900 nm
Resolution	0.5 nm
Detector Quantum Efficiency	25%
Detector Output	10 V/nW
Equivalent Noise	250 V
Viewport	2.75" CF
External Dimensions	9.0" x 25.5" x 10.1" (22 cm x 65 cm x 26 cm)
In Vacuum Length	1.25" x 13.1" (3.2 cm x 34 cm)
Travel Distance	Up to 8" (20.3 cm)
Target Distance	2" (5.1 cm)
Computer Requirements	Windows 9x, 2000, XP

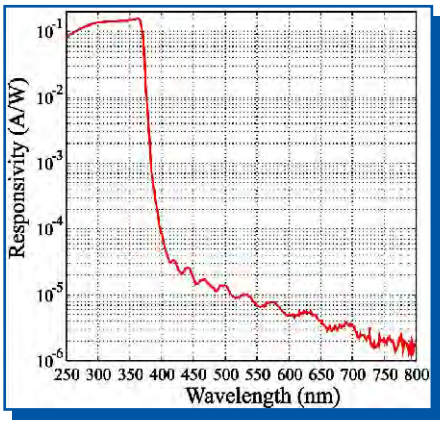
Model	Description
CL-0-2.75	Base In-Situ CL Instrument
CL-0-F	Fiber Based In-Situ CL System for Minimum Optical Access
RH-CBL	Cable Set
CL-4-6	In-Situ CL System 6" Mounting Flange Optional Ports for Pyrometer

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

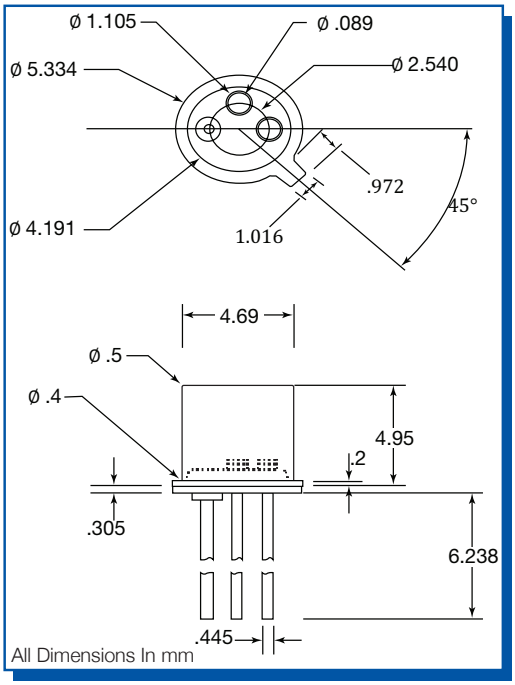
UV-A Photodetector

Engines for Thin Film Innovation

UV-A Detector



GaN detectors have a sharp responsivity cutoff at about 360 nm.



TO-46 Standard package with UV-glass windows cap

Description

UV-A detectors are small, robust, solid-state photodiodes fabricated using the III-V materials system. These detectors offer high quantum efficiency at wavelengths less than 360 nm and high rejection of response to visible and infrared wavelengths. These detectors are especially attractive for visible blind applications.

The standard package is a TO-46 header with cap. Other types of packaging are available including ones with built-in amplification.

Features

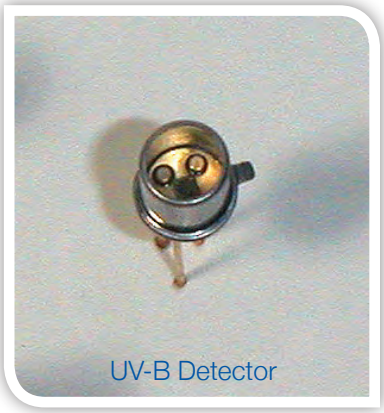
- UV Curing and Drying
- Combustion Monitoring
- Arc Detection
- Phototherapy
- Sterilization Control
- Spectroscopy
- Biological Agent Detection
- Solar Irradiance Measurement

Specifications	
Active Area	0.5 mm^2
Responsivity @ 360 nm	0.15 A/W typ.
Rejection @ > 400 nm	>5x10^3
Shunt Resistance (-10 mV)	>100 MΩ
Series Resistance	<1 kΩ
Package Type	TO-46

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

UV-B Photodetector

Engines for Thin Film Innovation

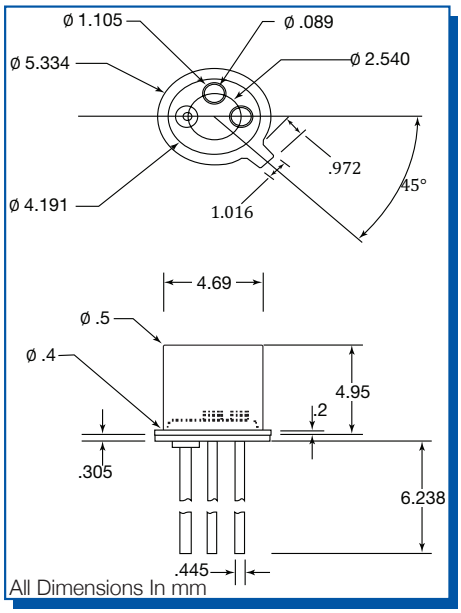

UV-B Detector

Description

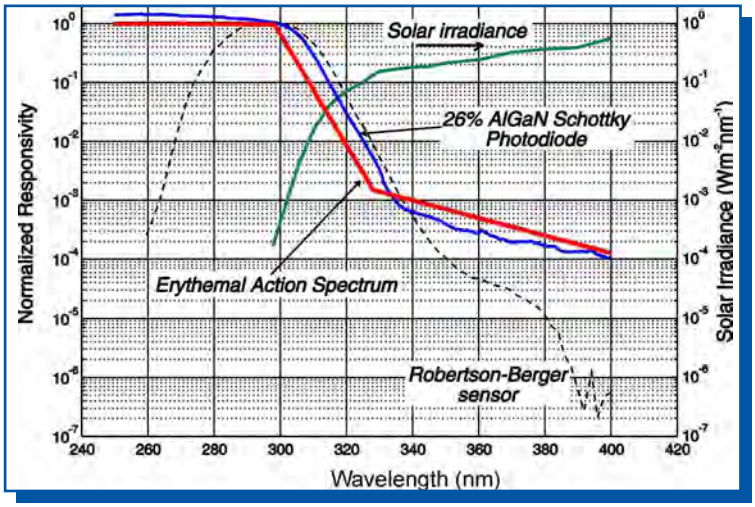
UV-B Schottky detectors are small, robust, solid-state photodiodes that provides a close match to the standard erythemal response. The capability of sunlight to induce erythema (sunburning) is strongly dependent on wavelength. Radiation in the UV-B band (280 – 320 nm) is primarily responsible. These sensors provide 10 rejection of all visible peak and infrared wavelengths longer than 400 nm. The photovoltaic efficiency of the UV-B sensor is more than 10% of the fundamental quantum efficiency limit, orders of magnitude higher than standard phosphor conversion techniques. The standard package is a TO-46 header with cap. Other types of packaging are available including ones with built-in amplification.

Features

- Erythemal Response Matching
- Solar Irradiance Measurement
- Climatological and Biological Studies
- UV Curing and Drying
- Combustion Monitoring
- Spectroscopy
- Sterilization Control
- Arc Detection



TO-46 Standard package with UV-glass windows cap



Specifications

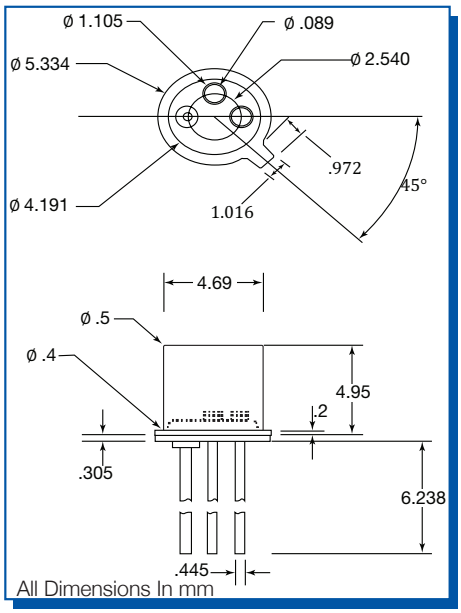
Active Area	0.5 mm^2
Responsivity @ 300 nm	0.03 A/W typ.
Rejection @ > 400 nm	$>10^4$
Shunt Resistance (-10 mV)	>1 G
Series Resistance	<1 k
Package Type	TO-46

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

UV-C Photodetector

Engines for Thin Film Innovation


UV-C Solar-Blind Detector



TO-46 Standard package with UV-glass windows cap

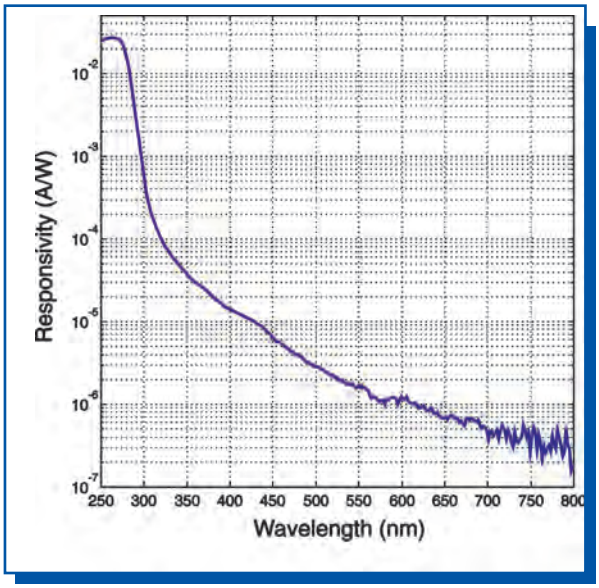
Description

UV-C Schottky detectors are small, robust, solid-state solar-blind photodiodes designed to respond primarily to ultra-violet radiation in the UV-C (<280 nm) spectral band. Responsivity falls to 10 of the peak value by 370 nm and continues to fall to 10 peak value by 500 nm. Terrestrial solar light in the UV-C range is absorbed in the atmosphere primarily by ozone and does not reach the earth's surface. UV-C radiation is produced at the earth's surface by combustion processes and also by certain industrial processes. Detection of UV-C radiation produced by these processes—without background interference from solar radiation—can be a valuable tool for identification and control.

The standard package is a TO-46 header with cap. Other types of packaging are available, including ones with built-in amplification.

Features

- Combustion Monitoring
- Industrial Process Monitoring
- Missile or Artillery Fire Detection



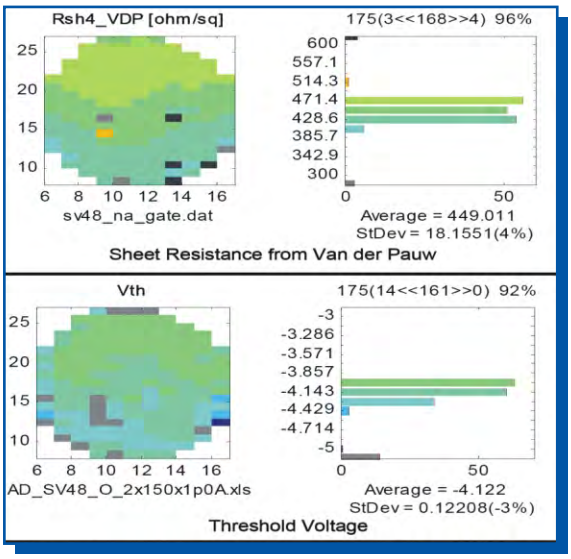
The above spectral responsivity graph illustrates the long wavelength rejection of the SVTA-UV-C responding photodiode.

Specifications	
Active Area	0.5 mm^2
Responsivity @ 360 nm	0.02 A/W typ.
Rejection @ > 400 nm	$>10^4$
Shunt Resistance (-10 mV)	>1 GΩ
Series Resistance	<1 kΩ
Package Type	TO-46

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com

High Performance III-Nitride Epitaxial Products on Sapphire and SiC Substrates

Engines for Thin Film Innovation



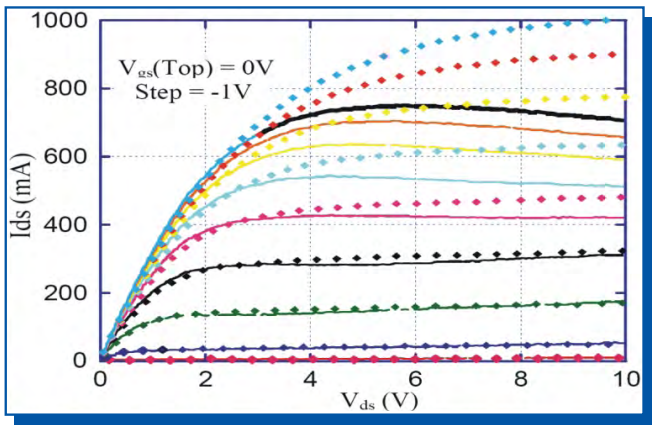
Uniformity of AlGaN HEMT device performance on 2" wafer

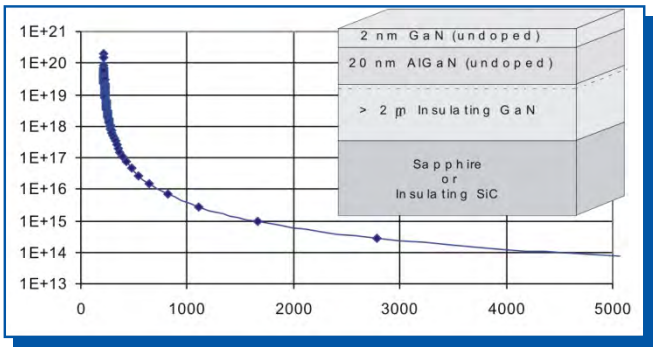
AlGaN/GaN High Electron Mobility Transistors (HEMTs)

- Custom AlGaN/GaN structures on sapphire and SiC
- Highly insulating undoped GaN buffers
- Extremely low defect GaN
- High 2DEG mobility values at high sheet densities
- High Al composition (up to 50%) AlGaN barrier layers
- Uniform thickness composition and device
- High dc and rf device performance

Applications

- Wireless and space communication
- Radar and range finding electronics
- High-Temperature electronics
- High-power and low noise amplifiers





HEMT DC and RF Performance

0.25 mm Device	Measured Values
I_{ds}max	1,397 (mA/mm)
I_{dss}	1,300 (mA/mm)
g_m	218 (mS/mm)
f_t	67 (GHz)
f_{max}	136 (GHz)

Note: The HEMT parameters depend on active layer structure.

Nitride HEMT Parameters

Parameter	Measured Values
2DEG Mobility at 300 K	1,200 – 1,500 (cm^2/Vs)
Sheet Carrier Density	0.5 to 3 x 10^{13} (cm^{-2})
Insulting GaN Buffer	N_D < 10^{14} (cm^{-3})
Thickness Uniformity	< ± 3% (2" Wafer)
Composition Uniformity	< ± 5% (2" Wafer)

7620 Executive Drive | Eden Prairie, MN 55344-3677 | USA
Phone: 952-934-2100 | Fax: 952-934-2737 | Email: sales@svta.com | www.svta.com