

VALVED PHOSPHORUS SOURCE VGCS

- Produces pure P_2 species ($P_2 / P_4 > 150$)
- Large crucible capacity of 420 cm³
- Reliable large cross-section cone valve
- Fast, stable and reproducible flux control
- Safe cell loading and operation
- Based on GaP decomposition
- Compatible to most MBE systems

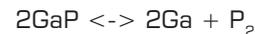


VGCS 100-420 mounted to VADP 100-63 adapter with DN63CF (O.D. 4.5") mounting flange

The Valved GaP Compound Source VGCS is a high purity phosphorus (P_2) source, based on the decomposition of high purity GaP. The concept is derived from our DECO effusion cells to which a reliable mechanical valve mechanism is added for rapid beam flux control.

Full MBE compatibility is reached by the integrated Gallium-Trapping-System, the integrated water cooling as well as the use of high purity inert materials such as Pyrolytic Boron Nitride (PBN) or Tantalum for all parts in the direct phosphorus path.

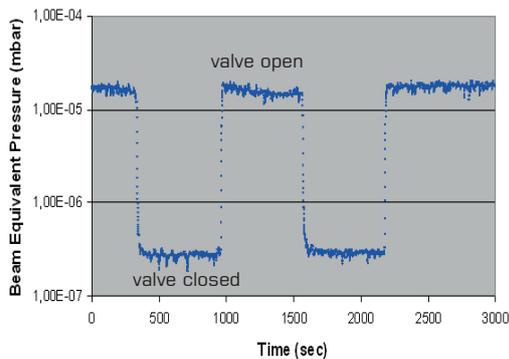
The PBN crucible in the reservoir of the source is loaded with single crystalline GaP pieces. At high temperatures at about 800-1000°C there is a balance in the reservoir between



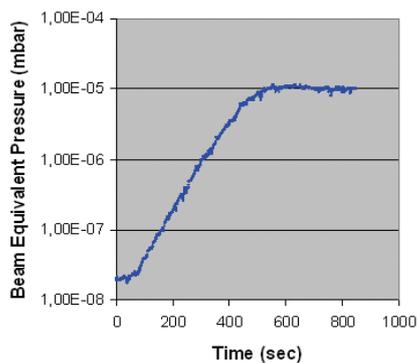
P_2 is ejected out of the source towards the substrate wafer in case the valve is open. The Ga is efficiently trapped within the reservoir. White P is not formed at all within the reservoir due to the excess Ga.

In contrast to sources using elemental phosphorus only minor amounts of white phosphorus are formed within the cell. The formation of white phosphorus within the MBE chamber is significantly reduced due to the direct formation of P_2 species from the decomposition of single crystal GaP chunks with purity 6N-7N.

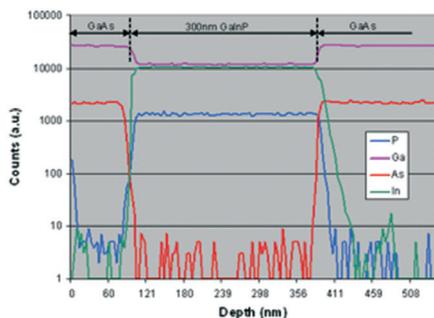
Operation of the mechanical valve unit shows fast, stable and reproducible flux control. The wide angle cone valve mechanism with its large cross section allows improved pumping of the GaP reservoir and excludes valve sticking. Together with our valve controller an easy handling and integration to your MBE system is provided.



Beam equivalent P_2 pressure vs. time, with valve closed/open



BEP during ramp 800°C to 1020°C (valve open), flux can be adjusted within minutes due to high reservoir temperature



SIMS of GaInP on GaAs buffer layer on (100) GaAs substrate with VACS and VGCS applied

Applications

The VGCS is designed for growth of phosphide compounds in III-V-MBE. It has been readily approved in industrial applications. The fast and reproducible flux control using a valve allows the growth of phosphide-arsenide heterostructures with very sharp interfaces like quantum wells and superlattices. It is perfectly suited for applications in HEMTs, HBTs, GaInP laser diodes and other devices. InP as well as GaInP/InP quantum dot lasers have been prepared. The large crucible size makes the VGCS well suited for MBE research and production systems. The high purity of GaInP layers grown on GaAs substrates have been demonstrated by SIMS measurements (see figure on the front page). The contamination of the GaInP layer with oxygen and carbon is below the detection limit of about $5 \times 10^{16} \text{cm}^{-3}$ using highest purity single crystalline GaP source material.

Adapter VADP

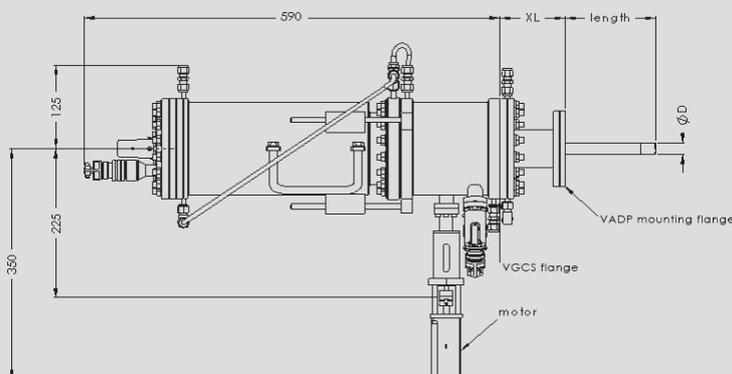
A VADP adapter connects the valved source to the MBE chamber. Design and dimensions will be customized according to your MBE system. The VADP is available with or without integrated water cooling shroud.

Motorized Valve Control Unit

The Motorized Valve Control Unit MVCU is designed for operating the valve of a valved source with a servo motor drive. Manual or remote control with 0-10 V analogue input signal is possible. The display indicates the linear position of the valve from 0 - 7.99 mm from fully closed to fully open position. The servo motor drive has a resolution of 0.01 mm/step and a high motor speed of 10 mm/s. The automatic zero calibration guarantees a highly reliable and reproducible operation of the valve unit. The MVCU housing is compatible with the 19" rack system.

Technical Data

Mounting flange	DN100CF (O.D. 6"), with VADP adapter DN40CF (O.D. 2.75") or DN63CF (O.D. 4.5")
Dimensions in vacuum	depend on used VADP adapter and cracking insert
Heating system	cell / valve: 2 separate heater circuits
Thermocouple	cell / valve: 2 type C thermocouples (W5%Re/W26%Re)
Bakeout temperature	max. 250°C
Outgassing temperature	cell crucible: 1300°C; valve: 500°C
Operating temperature	cell crucible: 700-1100°C; valve: 350°C
Cooling	integrated water cooling shroud
Flux control	integrated valve unit / cell temperature
Valve control	servo motor drive with control unit MVCU
Crucible	420 cm ³ (PBN)



Schematic drawing of the Valved GaP Compound Source VGCS
 (Drawing shows VGCS 100-420 mounted to VADP 100-63 adapter with DN63CF (O.D. 4.5") mounting flange)