

## SILICON SUBLIMATION SOURCE SUSI



Silicon sublimation source on a DN63 CF (O.D. 4.5") flange

- Growth of thin Si layers
- Si doping in III-V MBE (GaAs), with fast and precise flux control
- Ultra high purity silicon filament
- Highly P- or As-doped silicon filament for special doping applications
- Water cooled electrical contacts
- Inner filament shielding with Si parts
- No ceramic parts in the hot zone
- Compatible with most MBE systems

The Silicon Sublimation Source - SUSI - was developed for growing of thin Si layers, short period Si/Ge superlattices and Si/SiGe heterostructures, but it is also an excellent Si dopant source.

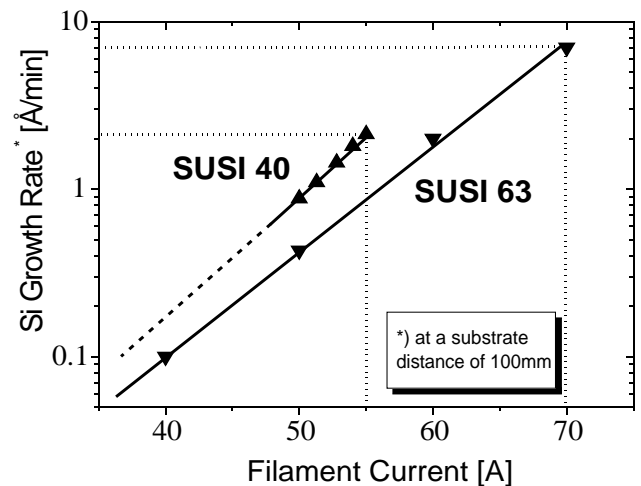
The SUSI allows growth of high crystal quality thin epitaxial Si layers, not otherwise possible with PBN crucible effusion cells. It is an optimal alternative to an e-beam evaporator, if highest purity, stable flux and low flux rates are required.

Our silicon sublimation source provides a very clean and constant Si flux at a low growth rate. Maximum growth rates of 7 Å/min and total layer thickness of 5µm pure Si with one filament are reported.

The specially designed free standing silicon filament arch is directly heated by electrical current and is surrounded by high purity silicon shielding parts only. Extreme heating of metal and ceramic parts is avoided by very effective water cooling of the electrical contacts. No insulating ceramic parts are used in the hot zone.

The SUSI works with a minimum impurity emission due to silicon shielding parts and water cooled current contacts. In a well designed MBE chamber a pressure in the  $10^{-10}$  Torr range is achieved while running the SUSI at maximum growth rate. The small thermal mass and the water cooled contacts make rapid doping concentration changes possible.

Special applications include boron and phosphorus doping in Si MBE. In this case highly doped Si source material is used. Arsenic doped Si source material can be used for Si doping in GaAs MBE.



Highest purity silicon parts of SUSI sublimation sources: filament arch, base plate and shielding tube

For doping in III-V MBE the usually needed silicon flux is considerably lower than 0.1 Å/min. The electrical current which provides this silicon flux rate is between 20 to 35 A for SUSI 40 and 40 to 50 A for SUSI 63. These values may be used as a guide to start calibration of the doping level as a function of the current. The low power operation guarantees a long lifetime without any servicing.

## Literature

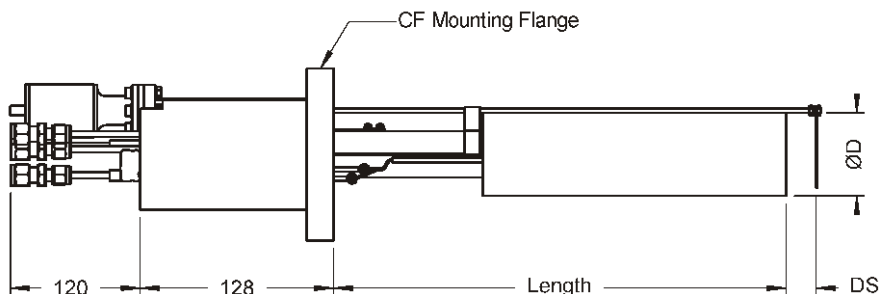
- [1] Encapsulation of phosphorus dopants in silicon for the fabrication of a quantum computer  
L. Oberbeck, N.J. Curson, M.Y. Simmons, R. Brenner, A.R. Hamilton, S.R. Schofield; Appl. Physics Letters 82, 17 (2002)
- [2] Comparison of P and Sb as n-dopants for Si molecular beam epitaxy  
J.F. Nützel and G. Abstreiter; Journal of Applied Physics 78, 937-940 (1995)
- [3] Microscopic symmetry properties of (001) Si/Ge monolayer superlattices  
Eberl, K.; Wegscheider, W.; Schorer, R.; Abstreiter, G.; Physical Review B-Condensed Matter, (1991) 43, 6, pp. 5188-5191
- [4] Group-IV element (Si, Ge and alpha-Sn) superlattices - low-temperature MBE  
Eberl, K.; Wegscheider, W.; Abstreiter, G.; Journal of Crystal Growth (1991) vol. 111, no. 1-4, pp. 882-888
- [5] Transmission electron-microscopy of short-period Si/Ge strained-layer superlattices on Ge substrates  
Wegscheider, W.; Eberl, K.; Cerva, H.; Oppolzer H.; Appl. Physics Letters (1989) vol. 55, no. 5, pp. 448-450

## Technical Data

<b>Mounting flange</b>	DN40 CF (O.D. 2.75") for SUSI 40 DN63 CF (O.D. 2.75") for SUSI 63
<b>Dimensions in vacuum</b>	<b>Length:</b> 216-400 mm ; <b>ØD:</b> 36 mm for SUSI 40 <b>Length:</b> 216-400 mm ; <b>ØD:</b> 55 mm for SUSI 63
<b>High purity silicon filament</b>	max. power 250W / 55A; max. flux 2Å/min; layer thickn. 2 µm (SUSI 40) * max. power 500W / 80A; max. flux 7Å/min; layer thickn. 5 µm (SUSI 63) *
<b>Temperature sensor</b>	W5%Re/W26%Re (type C)
<b>Bakeout temperature</b>	max. 250°C
<b>Cooling</b>	integrated water cooled current contacts
<b>Shutter</b>	integrated rotary shutter ( <b>S</b> ) (for SUSI 63 only; <b>ØD:</b> 62 mm)

\* max. flux and total layer thickness at 100 mm distance (source to sample)

Schematic drawing of the  
Silicon Sublimation Source  
(Drawing shows SUSI 63-S)



### Dr. Eberl MBE-Komponenten GmbH

Gutenbergstr. 8, D-71263 Weil der Stadt, Germany  
TEL +49 (0)7033 6937-0 FAX +49 (0)7033 6937-20  
sales@mbe-components.com  
www.mbe-components.com

