

## PRODUCTION SCALE EVAPORATION SOURCE PEZ-G

- Large capacity up to 55 kg Cu
- Very high flow rate up to 220 g/h for Cu
- Designed for easy maintenance
- Proprietary encapsulation of heater and shielding
- Encapsulated thermocouple
- Pyrometric temperature control option



PEZ-G Production Scale CIGS Evaporation Source

Our PEZ-G series sources are proven technology for industrial production of  $\text{Cu(In,Ga)Se}_2$  (CIGS) thin film solar cell co-evaporation. They are well tested in the field.

The unique source design provides extraordinary performance. In every detail the source has been constructed for a long life time and easy and fast maintenance. Our proprietary and patented encapsulation of the inner source parts and careful selection of materials and their combination ensures virtually no degradation. The sophisticated modular setup of the source with easily releasable fastenings allows rapid service routines and part replacements if necessary.

The robust carbon based dual filament heater is designed for long-term application in production.

Different crucible sizes are available to fit several production relevant demands. Standard sizes are  $2000\text{cm}^3$  or  $4000\text{cm}^3$ ; other sizes can be provided on request.

The source is mounted in a cooling shroud, minimizing thermal input to the chamber and providing mechanical protection. The in-vacuum length of the source is variable and can be adjusted by an adapter flange.

Using a beam shaping insert enables unique evaporation profiles for enhanced material efficiency and process optimization. The customization is supported by our proven simulation technology.

MBE-Komponenten provides support in the design of customer-specific research or production systems. Results are a customized source geometry optimized for specified layer uniformity and material utilization.

Co-evaporation processes can be simulated on request. The simulations are based on geometric and Monte Carlo method calculations. Typical results include the lateral layer thickness distribution and material composition for multiple material co-evaporation processes on semiconductor wafers as well as on large area substrates.

### Applications

Main applications of the PEZ-G series evaporators are:

- CIGS thin film solar cell deposition
- Kesterite thin film solar cell deposition
- Metallization processes in PVD systems
- OLED or organic solar cell deposition

Technical Data

Model	PEZ-G 200	PEZ-G 150	PEZ-G 100	PEZ-G 63	
nominal crucible volume <sup>1)</sup>	10000 cm <sup>3</sup>	4000 cm <sup>3</sup>	2000 cm <sup>3</sup>	800 cm <sup>3</sup>	160 cm <sup>3</sup>
base charge volume <sup>2)</sup>	6000 cm <sup>3</sup>	2400 cm <sup>3</sup>	1200 cm <sup>3</sup>	480 cm <sup>3</sup>	100 cm <sup>3</sup>
operation temperature	up to 1500°C	up to 1500°C	up to 1500°C	up to 1500°C	up to 1500°C
evaporation rate (for Cu) <sup>3)</sup>					
max.	up to 220 g/h	up to 130 g/h	up to 70 g/h	up to 35 g/h	up to 10 g/h
typical	65 g/h	35 g/h	20 g/h	10 g/h	3 g/h
power supply (for Cu) <sup>3)</sup>					
top heater	10000 W	5200 W	5000 W	2400 W	1500 W
bottom heater	5000 W	3300 W	2400 W	1500 W	750 W
typical power consumption					
(for Cu) <sup>3)</sup> top heater	10000 W	5200 W	3300 W	2000 W	600 W
bottom heater	2000-3000 W	1200-1500 W	600-1100 W	400-600 W	150-220 W
flange sizes O.D. <sup>4)</sup>					
water cooling	12" (DN250CF)	10" (DN200CF)	8" (DN150CF)	6" (DN100CF)	6" (DN100CF)
evaporation source	10" (DN200CF)	8" (DN150CF)	6" (DN100CF)	4,5" (DN63CF)	
water cooling	cooling shroud, base flange, electric feedthrough			cooling shroud	
water flow rate	270 l/h	150 l/h	90 l/h	75 l/h	30 l/h

<sup>1)</sup> other sizes on request

<sup>2)</sup> depending on installation angle: 20° reduces the base charge volume to 84%, correspondingly 30° reduces the volume to 75%

<sup>3)</sup> Cu has the highest demands concerning power consumption; in usual applications evaporation rates for Ga and In are not limited by the source

<sup>4)</sup> adapter flanges and base flanges can be customized

Results from large scale CIGS production systems indicate the following:

- Stable operation over several days
- Very good material efficiency >40% due to beam shaping
- Excellent homogeneity of film composition on large glass substrates [Cu]/([In]+[Ga]): <± 2.5 %
- Excellent CIGS material quality
- High efficiency of solar cells out of full scale module production
- Low cost of ownership: long lifetime of heaters and shieldings

