SCU450 / SCU800 / SCU1200 / SCU1500
Silicon Crystallization Units
Benchmark for Gen5 to Gen8 Multi- and Mono-Crystalline Silicon Ingot Production
Silicon Crystallization Units (SCU)

Benchmark for Solar-Grade Silicon Ingot Production

ALD’s silicon crystallization units are automated furnaces for high-throughput melting and crystallizing solar-grade silicon into ingots for processing into wafers for solar cells. They produce one high-quality multi- or mono-crystalline silicon ingot per cycle.

Sizes and Configurations SCU Model Series

SCU furnace models are available for the Gen5 to Gen8 crucible generation.

The SCU450 and SCU800 systems are configured and optimized for Gen5 and Gen6 silicon ingot production with a capacity range of 400 - 950 kg silicon per cycle corresponding to an annual solar power output of approx. 10 - 15 MWp.

The Next Generation SCU furnace models, SCU1200 and SCU1500, enable substantially lower ingot manufacturing costs and will meet your long term production requirements.

SCU1200 and SCU1500 furnaces are configured and optimized for Gen7 and Gen8 ingot production with a capacity range of 1100 - 1800 kg silicon per cycle corresponding to an annual solar power output of approx. 20 - 27 MWp.

Exclusive Design Features

Top, Bottom and Side Heaters
Independently controllable graphite resistance heaters provide high melt rates, flat temperature profiles and strictly vertical heat flux. The Top, Bottom and Side Heater arrangement permits for excellent electromagnetic melt stirring to minimize silicon carbide and nitride inclusions and eliminates seed melting in advanced crystallization processes.

Heat Extraction System
Unique Triple Heat Gate system in combination with an Active Heat Exchanger enables excellent silicon ingot crystallization and precise control of all important
High-Throughput, Multi- and Mono-Crystalline Silicon Ingot Production

SCU Systems from the Technology Leader

- Gen5 to Gen8 ingot production
- Highest yields and excellent ingot quality
- Intrinsic furnace safety design
- Best system productivity available in the market
- Shortest cycle times and low specific energy/argon consumption
- Lowest cost of ownership

It is essential for minimum down time and safe operator conditions during cleaning and maintenance routine.

**Advanced Safety Design**

SCU systems are equipped with multiple **Advanced Safety Features** reflecting ALD’s extensive know how in handling multi-ton loads of liquid silicon and other molten, reactive metals. Inherent operator and facility protection is assured by double layer protection shields of copper and refractory tiles across the entire SCU bottom area, PLC safety interlocks, continuous diagnostics and high cross-section chamber pressure relief devices in the event of a crucible failure and silicon spill.

**Central Control Center**

Up to 24 SCU systems are remotely controlled from a redundant server based **Central Control Center**. Maximum operator safety and comfort includes UPS, flexible process recipe administration and safe process data storage, based on world class SIEMENS PLC’s, computers and software.

**Top Loading**

The **Top Loading** system provides for excellent accessibility and visibility of the process area and fast, safe and accurate loading/unloading of large silicon ingots using established lifting tools and standard overhead cranes.
**HPM and Mono²™ Processes**

**Process Characteristics and Technology Transfer**
- Standard SCU systems equipped with additional instrumentation/software meet all requirements for HPM and Mono²™ processes.
- Processes for ingots grown from multi- and mono-crystalline seed layers.
- Methods for seed manufacturing and replication methods.
- Patented technology for seed layer preservation and controlled crystallization start.

**Premium Ingot Quality**
- Mono²™: Mono-crystalline ingot casting.
- Substantially higher cell efficiencies compared with conventional ingot casting.
- Lower manufacturing cost than mono-CZ process.
- Full square cells.
- Retrofit process/equipment upgrade and license available for standard ALD SCU systems.

**HPM and Mono²™ Process Principle**
1. Load multi- or mono-crystalline seeds at crucible bottom.
2. Load poly-silicon chunks above seed layer.
3. Melt down the feedstock.
4. Keep seed layer partially solid.
5. Initial uniform and controlled crystal growth on seed layer.
7. Cut top, bottom and side from ingots.
8. Cut ingot into bricks.

**Mono²™**
- bottom plate and ingot with mono crystalline structure.

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Unique Silicon Melting and Crystallization Concepts and Furnace Designs

**VIM Type Furnace**
Vacuum Induction Melting & Casting and Crystallization System
Separation of Melting from Crystallization

**SMC Type Furnace**
Silicon Melting & Crystallization
Quad Crucible System

**SCU Type Furnace**
Silicon Crystallization Unit
Single Crucible System

**PRODUCTION LINE Concepts**
Separation of Melting & Casting from Annealing & Cooling

Precision Engineering & Manufacturing from the Quality Leader

- More than 100 years of experience in design and manufacture of advanced vacuum furnaces
- Worldwide sales and service network
- Several hundred SCU systems equal to more than 5 GWp annual production capacity installed in the world’s leading solar industry companies
- Every system meets European safety and quality standards
- Customized solutions and concepts for silicon ingot production
- Unique experience in handling of more than 5 t liquid silicon
## Technical Data

<table>
<thead>
<tr>
<th></th>
<th>SCU450</th>
<th>SCU800</th>
<th>SCU1200</th>
<th>SCU1500</th>
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</thead>
<tbody>
<tr>
<td>Crucible / Ingot Generation [m]</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
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<tr>
<td>Crane Hook Height [m]</td>
<td>4.8</td>
<td>5.2</td>
<td>5.4</td>
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<tr>
<td>Overhead Crane Capacity [t]</td>
<td>2</td>
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<td>3</td>
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<tr>
<td>Max. Operating Temperature [°C]</td>
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<td>1,570</td>
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<tr>
<td>Ultimate Vacuum [Pa]</td>
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<tr>
<td>Inert Gas</td>
<td>Ar, He (max. 1,000 mbar)</td>
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<tr>
<td>Connected Power [kVA]</td>
<td>200</td>
<td>250</td>
<td>400</td>
<td>500</td>
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<tr>
<td>Energy Consumption per Cycle [kWh/kg]</td>
<td>3,300</td>
<td>5,200</td>
<td>7,200</td>
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<tr>
<td>Argon Consumption per Cycle [Nm³]</td>
<td>60</td>
<td>80</td>
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<tr>
<td>Cooling Water Consumption [l/min]</td>
<td>170</td>
<td>190</td>
<td>300</td>
<td>350</td>
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<tr>
<td>Nominal Batch Capacity [kg]</td>
<td>450</td>
<td>800</td>
<td>1,200</td>
<td>1,500</td>
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<tr>
<td>Batch Capacity Range [kg]</td>
<td>400 - 550</td>
<td>600 - 950</td>
<td>1,000 - 1,300</td>
<td>1,350 - 1,700</td>
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<tr>
<td>Ingot Crystal Structure</td>
<td>Multi-Crystalline</td>
<td></td>
<td></td>
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<td>Annual Production Capacity [MWp]</td>
<td>10 - 13</td>
<td>14 - 16</td>
<td>19 - 23</td>
<td>23 - 27</td>
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<tr>
<td>Retrofit / Upgrade for Advanced Processes (HPM, Mono™)</td>
<td>Yes</td>
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