



Product catalog



Material Science  
Research Equipment

# FURNACES

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For customizations, more products and information, please contact us.

# 1. Muffle Furnaces

## 1.1. Muffle Furnaces 400-1250°C



### 5-side Heating Muffle Furnace - KSL-1200X-MAX

Chamber Size : 500 mm x 500 mm x 500 mm  
5-side heating + Freestanding heating elements :  
uniformity, increase heating rate  
Working Temperature : 1200 °C continuously without an alloy chamber. 1000°C continuously with an alloy chamber.  
Heating rate : 10 °C/min (recommended)  
Temperature Control Accuracy :  $\pm 1$  °C  
\*Refractory Alloy Chamber for Debinding (Optional)  
\*Economic approach to anneal samples  
\*Under relatively controlled atmosphere (not airtight)



### Muffle Furnace with Programmable Controller- KSL1200X-M

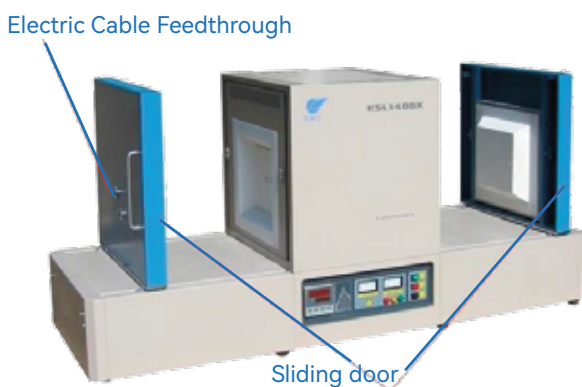
Chamber Size : 305 mm x 305 mm x 305 mm  
Working Temperature : max. 1200 °C continuously  
Heating Rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C

## 1.2. Muffle Furnaces 1300-1500°C



### Bench-Top Muffle Furnace with Quartz Window - KSL-1500X-W

Chamber Size : 150 mm x 150 mm x 149 mm ; with a 60 mm  $\Phi$  window for IR camera or optical device  
Working Temperature : max. 1500 °C < 1 hour ;  
Continuous: max. 1450 °C  
Heating Rate :  $\leq 10$ °C/min  
Temperature Control Accuracy :  $\pm 1$  °C



### Muffle Furnace with Double Doors & Slide Rails - KSL-1500X-DD

Simple loading and fast cooling  
Chamber Size : 250 mm x 250 mm x 300 mm  
Working Temperature : max. 1500 °C < 1 hour ;  
Continuous : max. 1400 °C  
Heating Rate :  $\leq 5$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C

# 1. Muffle Furnaces

## 1.3. Muffle Furnaces 1600-1700°C



### Compact Muffle Furnace - KSL-1700X-S

Energy Saving : ( $< 1$  kW at  $10$  °C/min) using 1800 grade fiber alumina with reflective coating  
Chamber Size : 120 mm x 120 mm x 120 mm  
Working temperature : max.  $1700$  °C  $< 3$  hour ;  
Continuous : max.  $1600$  °C  
Heating Rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C



### Large High Temperature Box Furnace - KSL-1700X-A7

Chamber Size : 600 mm x 600 mm x 600 mm  
Working Temperature : max.  $1700$  °C  $< 30$  min ;  
Continuous : max.  $1600$  °C  
Heating Rate :  $10$  °C/min ( $< 1400$  °C) ;  $5$  °C/min ( $1400$  °C –  $1600$  °C) ;  $2$  °C/min ( $> 1600$  °C)  
Temperature Control Accuracy :  $\pm 1$  °C

## 1.4 Muffle Furnace 1700 – 2000 °C



### Bench-Top Muffle Furnace - KSL-1800X-KA3

Chamber Size : 200 x 200 x 300 mm  
Working Temperature : max.  $1800$  °C  $< 1$  hour ;  
Continuous : max.  $1750$  °C  
Heating Rate : RT –  $10$  °C/min (RT –  $1600$  °C),  $2 - 5$  °C/min ( $1600 - 1800$  °C)  
Temperature Control Accuracy :  $\pm 1$  °C

### 2.1. Tube Furnace Single Zone



#### **Bench-Top Vacuum and Atmosphere Tube Furnace - GSL-1750X-60**

Heating Zone Length : 457 mm  
Alumina Tube Dimensions: 60 mm OD x 54 mm ID x 1000 mm Length  
Working Temperature : max. 1750 °C < 2 hours ;  
Continuous : max. 1700 °C  
Heating Rate :  $\leq 5$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C  
Vacuum Level :  $5 \cdot 10^{-2}$  torr by mechanical pump,  $1 \cdot 10^{-5}$  torr by turbomolecular pump

### 2.2. Tube Furnace Multi-Zone



#### **Three Zone Split Tube Furnace with Flange & Alumina Tube - OTF-1600X-III**

Heat Zone Length : 600 mm  
Alumina Tube Dimensions: 80 mm OD x 74 mm ID x 1200 mm Length  
Working Temperature : max. 1550 °C  $\leq 1$  hour ; Continuous : max. 1500 °C  
Heating rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C  
Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump,  $1 \cdot 10^{-5}$  torr by turbomolecular pump  
Optional Upgrade : Eurotherm temperature controller with temperature accuracy :  $\pm 0.1$  °C

## 2. Tube Furnaces



### 5-Zone Tube Furnace - OTF-1200X-V-OD

Heating Zone Length : 870 mm

Quartz Tube Dimensions:

- Option 1: 80 mm OD x 74 mm ID x 1400 mm Length ;

- Option 2 : 100 mm OD x 94 mm ID x 1400 mm Length ; Option 3 : 130 mm OD x 124 mm ID x 1400 mm Length

Working Temperature : max. 1200 °C < 1 hour ; Continuous: max. 1100 °C

Heating Rate :  $\leq 20$  °C/min

Temperature Control Accuracy:  $\pm 1$  °C

Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump,  $1 \cdot 10^{-4}$  torr by turbopump



### 12 Zone Ultra-Long Split Tube Furnace - OTF-1200X-6M

Heating Zone Length : 6000 mm

Quartz Tube : 127 mm OD x 119 mm ID x 6500 mm Length

Working Temperature : max. 1100 °C < 1 hour ; Continuous : max. 1050 °C

Heating Rate :  $\leq 20$  °C/min

Temperature Control Accuracy:  $\pm 1$  °C



## 3. Hybrid Furnaces



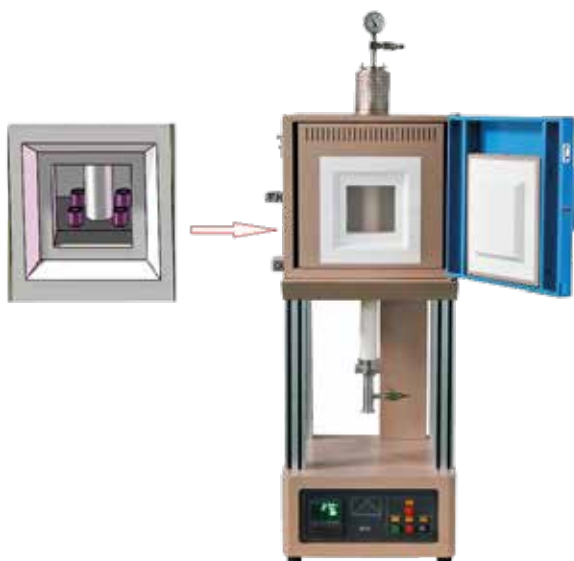
### Compact Hybrid Furnace Muffle/Tube 2-In-1 - KSL1100XSH

Glove Box Compatible  
Energy Saving : ~ 30 % less power consumption  
Chamber Size : 100 mm x 100 mm x 100 mm  
Quartz Tube : Option 1 : 25 mm OD x 20.5 mm ID x 450 mm Length ; Option 2 : 50 mm OD x 43.5 mm ID x 230 mm Length  
Working Temperature : max. 1000°C < 1 hour ;  
Continuous: max. 900 °C  
Heating Rate : 30 °C/min  
Temperature Control Accuracy :  $\pm 1$  °C



### Compact Hybrid Furnace - KSL-1700X-HL

Chamber Size : 102 mm x 102 mm x 102 mm  
Alumina Tube Dimensions : 18 mm OD x 13 mm ID x 600 mm Length  
Working Temperature : max. 1700 °C < 1 hour ; Continuous : 1600 °C  
Heating Rate : 5 °C/min for  $T \in [1400, 1600]$  °C ;  $\leq 10$  °C/min for  $T \leq 1400$  °C  
Temperature Control Accuracy :  $\pm 1$  °C  
Vacuum Level :  $5 \cdot 10^{-2}$  torr by mechanical pump,  $1 \cdot 10^{-5}$  torr by turbomolecular pump



### Hybrid High Temperature Tube & Box Furnace - GSL-1700X-50VTB

Chamber Size : 150 mm x 150 mm x 150 mm  
Alumina Tube : 50 mm OD x 40 mm ID x 1000 mm Length  
Working Temperature : max. 1700 °C < 1 hour ; Continuous : 800 – 1600 °C  
Heating Rate : 10 °C/min (< 1200 °C) ; 5 °C/min (> 1200 °C)  
Temperature Control Accuracy :  $\pm 1$  °C  
Vacuum Level :  $5 \cdot 10^{-2}$  torr by mechanical pump,  $1 \cdot 10^{-5}$  torr by turbomolecular pump

## 4. Chemical Vapor Deposition (CVD)

### 4.1. Chemical Vapor Deposition (CVD)



#### Single Zone Tube Furnace – OTF-1200X-80-F3LV

3 Channel Gas Mixer : Three gas flow-meters. Four pressure meters : for 3 flowing gas and mixing tank.  
Heating Zone Length : 400 mm  
Quartz Tube : 80 mm OD x 75 mm ID x 1000 mm Length  
Working Temperature : max. 1200°C; Continuous  $\leq$  1100 °C  
Heating Rate :  $\leq$  20 °C/min  
Temperature Control Accuracy :  $\pm$  1 °C  
Vacuum level :  $1 \cdot 10^{-2}$  torr by mechanical pump



#### Three Zones Tube Furnace for CVD – OTF-1200X-4-III-9HV

Up to 9 Channels Mass Flow Meters Gas Control System  
Heating Zone Length : 880 mm (3 zones: 220 mm + 440 mm + 220 mm)  
Quartz Tube : 100 mm OD x 92 mm ID x 1400 mm Length  
Working Temperature : max. 1200 °C < 1 hour ; Continuous : max. 1100 °C  
Heating Rate :  $\leq$  20 °C/min  
Temperature Control Accuracy :  $\pm$  1 °C  
Vacuum Level :  $1 \cdot 10^{-4}$  torr by turbomolecular pump

## 4. Chemical Vapor Deposition (CVD)

### 4.2. Plasma Enhanced CVD



#### Rotary Tube Furnace for Powder PE-CVD & Cleaning – OTF-1200X-III-R5-PECVD

Heating Zone Length : 600 mm (150+300+150 mm three zones)  
Quartz Tube : 130 mm OD x 60 mm ID x 1650 mm Length, specially designed tube for rotary furnace only  
Working Temperature : max. 1200 °C < 1 hour ; Continuous : max. 1100 °C  
Heating Rate : ≤ 10 °C/min  
Temperature Control Accuracy : ± 1 °C  
Vacuum pump (optional): power is dependent upon the pumping capacity.  
Furnace Tilt Angle: 0 – 15 °  
4 Gas Flow Control with Flow range 1 to 4 : 1 – 500 SCCM  
RF Plasma Generator : max. 300 W with ± 1 % stability; RF Frequency : 13.56 MHz with ± 0.005 % stability  
Tube rotation speed : 2 – 10 RPM

### 4.3. Direct Vaporizing Deposition (DVD)



#### Tube Furnace for DVD & RTP – OTF-1200X-S-DVD

Two magnets and a quartz boat for sample sliding  
Heating Zone Length : 200 mm ; single zone  
Quartz Tube Dimensions : 50 mm OD x 44 mm ID x 1000 mm Length  
Working Temperature : max. 1200 °C < 1 hour ;  
Continuous : max. 1100 °C  
Heating Rate : ≤ 20 °C/min  
Temperature Control Accuracy : ± 1 °C  
Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump

## 4. Chemical Vapor Deposition (CVD)



### Tube Furnace with Automatic Sliding of Internal Crucible - OTF-1200X-80-DVD

Air-tight automatic sliding mechanism  
Heating Zone Length : 200 mm ; single zone  
Quartz Tube : 50 mm OD x 44 mm ID x 1000 mm Length  
Working Temperature : max. 1200 °C < 1 hour ; Continuous : max. 1100 °C  
Heating Rate :  $\leq 20$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C  
Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump

### 4.4. Hybrid Physical-Chemical Vapor Deposition (HPCVD)



3 pcs fused quartz tube

### Three Zone HPCVD Tube Furnace - OTF-1200X-III-HPCVD-S3

Sequential Source Feeding System permits 1-3 source crucibles at a time  
Heating Zone Length : 900 mm (3 zones : 300 mm + 300 mm + 300 mm)  
Quartz Tube : 1 pcs fused quartz tube : 130 mm OD x 122 ID x 1200 mm Length; 3 pcs fused quartz tube : 25 mm OD x 21 mm ID x 1200 Length  
Working Temperature : max. 1200 °C < 1 hour ; Continuous : 100 - 1100 °C  
Heating Rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C  
Independent gas inlet and flow-control  
Sample Crucible Movement Control

## 4. Chemical Vapor Deposition (CVD)



### Plasma Enhanced HPCVD Rotary Furnace - OTF-1200X-II-PEC4

Heating Zone Length : 400 mm (2 zones : 200 mm + 200 mm)  
Quartz Tube : 102 mm OD fused quartz tube with mixing blade in the center  
Working Temperature : max. 1300 °C; Continuous : max. 1200 °C  
Heating Rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C  
Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump  
Furnace Tilt Angle : 0 – 30°  
RF Plasma Generator : max. 300 W with  $\pm 1$  % stability; RF Frequency : 13.56 MHz with  $\pm 0.005$  % stability  
Tube Rotation Speed : 0 – 5 RPM  
Evaporator : 0.7ml alumina crucible with tungsten heating coil surrounded  
4-channel gas mixing station

### 4.5. Microwave Plasma Assisted CVD



### Microwave Plasma Assisted CVD Rotary Furnace - GSL-1200R-MWPE

Microwave Dimensions : 560 mm Length x 410 mm Width x 340 mm Height  
Working Temperature : max. 1200 °C < 30 minutes and min. 800 °C with heating module assisted ;  
Continuous :  $\leq 1100$  °C with heating module assisted and Plasma ; Continuous : max. 750 °C only by microwave  
Heating Rate :  $\leq 20$  °C/min (programmable)  
Temperature Control Accuracy :  $\pm 1$  °C  
Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump,  $1 \cdot 10^{-5}$  torr by turbomolecular pump  
Microwave Generator : 2.45 GHz. 1400 W  
Tube Rotation Speed : 0 – 5 RPM

## 5. High Pressure Furnace



### Compact High Pressure Gas Tube Furnace (HIP) - OTF-1200X-S-HP-30A

Heating Zone Length : 200 mm (single zone)

Ni-based Superalloy Tube Vessel : 30 mm OD x 12 mm ID x 580 mm Length

Working Temperature vs Pressure : max. 800 °C under max. 20 MPa ; max. 900 °C under max. 12 MPa ; max. 1000 °C under max. 6 MPa ; max. 1100 °C under max. 4 MPa

Heating Rate :  $\leq 10$  °C/min

Temperature Control Accuracy :  $\pm 1$  °C

Compatible with ultra-highly oxidizing or inert gas atmosphere : O<sub>2</sub> and inert gasses such as N<sub>2</sub>, Ar and He



### High Vacuum & High Pressure Chamber Furnace - GSL-800-L

310S stainless steel chamber : 720 mm  $\Phi$  x 900 mm Depth  
(Cleanliness level : up to Class 100)

Working Temperature :  $\leq 800$  °C (In a Flowing Atmosphere/Vacuum State)

Heating Rate :  $\leq 5$  °C/min

Temperature Control Accuracy :  $\pm 5$  °C

Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump,  $1 \cdot 10^{-5}$  torr by turbomolecular pump

Working Pressure : max. 750 °C under max. 0.25 MPa ; max. 500 °C under max. 0.35 MPa

1 channel mass flow meter with flow rate max. 5 L/min

## 6. Atmosphere Controlled Furnace



### 5 Side Heating Atmosphere Controlled Muffle Furnace - KSL-1200X-AC-5S

310 Stainless Steel Chamber Dimensions: Heating Area: 400 mm x 400 mm x 400 mm

Working Temperature : max. 1200 °C < 1 hour ; Continuous : max. 1100 °C

Heating Rate : < 10°C/min

Temperature Control Accuracy :  $\pm 1$  °C

Vacuum Level :  $1 \cdot 10^{-1}$  torr for oxygen or inert gas by standard thermal insulation material by mechanical pump ,  $1 \cdot 10^{-3}$  torr for high vacuum by special thermal insulation material by mechanical pump

Working Pressure : Pure O<sub>2</sub> or all types of inert gases : < 0.03 MPa (Pure O<sub>2</sub> need special modification for anti-oxidation upon request)

Water Cooling : 16 L/min recirculating water chiller to ensure the vacuum sealing and air-tight Muffle (protect the sealed O-ring)



### 1700 °C Max. Atmosphere Controlled Muffle Furnace - KSL1700X80AC

Chamber Size : 410 mm Length x 410 mm Width x 500 mm Height

Working Temperature : 800 – 1700 °C under air; 800 – 1500 °C under inert environment; 800 – 1500 °C under 5 % H<sub>2</sub>; 800 – 1400 °C under vacuum

Heating Rate :  $\leq 10$  °C/min

Temperature Control Accuracy :  $\pm 1$  °C

Vacuum Level : < 0.5 torr by mechanical pump

Water Cooling : required to prevent the front seal from melting (KJ6200 not included)

## 7. Hydrogen Gas Furnace

### 7.1. Hydrogen Gas Chamber Furnace



#### Hydrogen Gas Box Furnace - KSL-1600X-H5

Chamber Size : 400 mm Length x 400 mm Width x 400 mm Height  
Working Temperature : max. 1700 °C < 1 hour ; Continuous : max. 1600 °C  
Heating Rate :  $\leq 5$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C  
Recommended Gas Environment : H<sub>2</sub> or Ar  
2 Gas Flow Control : 1 for purging Inert gas before H<sub>2</sub> ; 1 for controlling H<sub>2</sub> gas flow  
Built-in H<sub>2</sub> burning control system : in case H<sub>2</sub> leakage, H<sub>2</sub> delivery valve will be shut down automatically

### 7.2. Hydrogen Gas Quartz Tube Furnace



#### Hydrogen Gas Tube Furnace with H<sub>2</sub> Detecting System - OTF-1200X-S5-H2

Heating Zone Length : 300 mm  
Quartz Tube : 130 mm OD x 120 mm ID x 750 mm Length  
Working Temperature : max. 1100 °C < 1 hour ; Continuous : max. 1000 °C  
Heating Rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C  
Hydrogen Detecting System : H<sub>2</sub> level > 20 % (LEL) , System will cut off H<sub>2</sub> source; turn off heating elements and purge nitrogen  
1 Gas Flow Control : adjust the flow rate 0 - 200 SCCM  
Hydrogen Torch and Lighter to burn out the exhaust

## 7. Hydrogen Gas Furnaces

### 7.3. Hydrogen Gas Alloy Tube Furnace



#### Three Zone Hydrogen Gas Tube Furnace - OTF-1200X-III-H2

Heating Zone Length : 600 mm ( 3 zones : 180 mm + 180 mm + 180 mm)

Ni-based Superalloy ( $\text{Cr}_{20}\text{Ni}_{25}\text{Al}_{15}$ ) Tube Dimensions : 80 mm OD x 72 mm ID x 1200 mm Length

Working Temperature : max. 1250 °C < 0.5 hour ; Continuous : max. 1200 °C

Heating Rate :  $\leq 5$  °C/min

Temperature Control Accuracy :  $\pm 1$  °C (Optional upgrade : Eurotherm temperature controller with temperature accuracy :  $\pm 0.1$  °C)

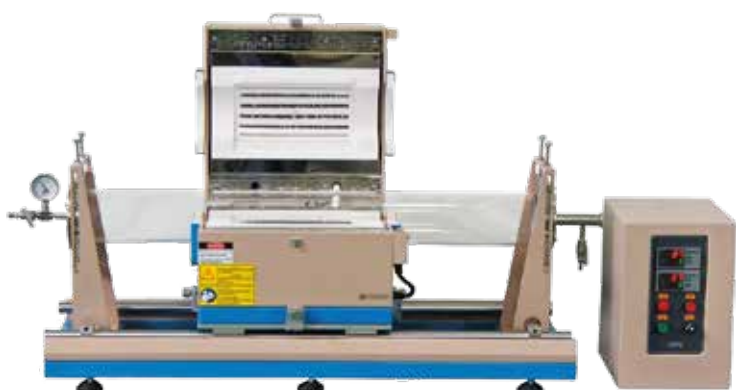
Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump ,  $1 \cdot 10^{-5}$  torr by turbomolecular pump

Two Hydrogen Detectors : in case  $\text{H}_2$  leakage,  $\text{H}_2$  generator and delivery valve will be shut down automatically

Pressure : 0.1 – 5 MPa depending on temperature

## 8. Rapid Thermal Processing (RTP)

### 8.1 Electric Heating RTP (SiC or SiMo rod)



#### Sliding Tube Furnace for Rapidly Thermal Processing - OTF-1200X-RTP-5S

Heating Zone Length : 300 mm  
 Quartz Tube Dimensions : 130 mm OD x 120 mm ID x 1100 mm Length  
 Working Temperature : max. 1200 °C < 0.5 hour ;  
 Continuous : max. 1100 °C  
 Heating rate : ≤ 20 °C/min  
 Cooling rate : ≤ 4 °C/s  
 Temperature Control Accuracy : ± 1 °C  
 Vacuum Level : 1·10<sup>-2</sup> torr by mechanical pump, 1·10<sup>-5</sup> torr by turbomolecular pump  
 Dual sliding rails. Sliding Range : 450 mm



#### Tube Furnace with Sliding Flanges for Fast Heating/Cooling - GSL1500X RTP50

Heating Zone Length : 152 mm  
 Mullite Tube : 50 mm OD x 44 mm ID x 304.8 mm Length  
 Sliding Length : 350 mm  
 Working Temperature : max. 1500 °C < 0.5 hour ;  
 Continuous : max. 1400 °C  
 Temperature Control Accuracy : ± 1 °C  
 Heating & Cooling Rate :

|                        |             |            |             |             |             |             |
|------------------------|-------------|------------|-------------|-------------|-------------|-------------|
| Temperature Range (°C) | RT - 800    | 800 - 1000 | 1000 - 1100 | 1100 - 1200 | 1200 - 1300 | 1300 - 1350 |
| Heating Rate (°C/s)    | 10          | 7          | 4           | 3           | 1.5         | 0.7         |
| Temperature Range (°C) | 1350 - 1000 | 1000 - 800 | 800 - 600   | 600 - 500   | 500 - 400   | 400 - 300   |
| Cooling Rate (°C/s)    | 14          | 7          | 5           | 3.76        | 2.5         | 1.36        |

### 8.2 Infrared(IR) Heating RTP



#### 2 Zone IR-Heating RTP Tube Furnace with Sliding Sample Holders - OTF-1200X-IR-IISL

Heating Zone Length : 390 mm (2 zones : 195 mm + 195 mm)  
 Quartz Tube Dimensions : 110 mm OD x 106 mm ID x 740 mm Length  
 Working Temperature : max. 900 °C < 10 min ; max. 800 °C < 0.5 hour ; Continuous : max. 600 °C  
 Heating Elements : 1.5 kW halogen heating tubes  
 Heating Rate : ≤ 50 °C/s under RT - 800 °C, ≤ 10 °C/s under 800 °C - 900 °C  
 Cooling Rate : ≤ 117 °C/min under atmospheric pressure  
 Temperature Control Accuracy : ± 1 °C  
 Vacuum Level : 1·10<sup>-2</sup> torr by mechanical pump, 1·10<sup>-4</sup> torr by turbomolecular pump  
 Sliding Rail Length : 400 mm

## 8. Rapid Thermal Processing (RTP)



### Atmosphere Controlled Bottom Loading Furnace - VBF-1100X-RTP-ASD

Heating Zone Length : 210 mm  $\Phi$  x 100 mm  
Sample Stage : 105 mm  $\Phi$  with a rectangular recess 76 mm x 58 mm  
Working Temperature : max. 100 °C  $\leq$  30 min ; Continuous : max. 1000 °C  
Heating Elements : 12 shortwave infrared lamps, 1.5 kW per lamp  
Heating Rate : 10 °C/s for T  $\in$  [room temperature, 900] °C  
Cooling Rate :  
- In Sealed Furnace Environment  
T  $\in$  [800, 350] °C, Cooling Rate : 55 °C/min;  
T  $\in$  [800, 350] °C, Cooling Rate : 200 °C/min.  
- In Open Furnace Environment  
T  $\in$  [350, 200] °C, Cooling Rate : 5 °C/min;  
T  $\in$  [350, 50] °C, Cooling Rate : 35 °C/min.  
Temperature Control Accuracy :  $\pm$  1 °C (Optional upgrade : Eurotherm temperature controller with temperature accuracy :  $\pm$  0.1 °C)  
Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump,  $1 \cdot 10^{-4}$  by turbomolecular pump  
Optional : Automated Robotic Assistance for fully automatic operation

### 8.3 Microwave Heating RTP



### Microwave Heated Tube Furnace - GSL-MW-25

Microwave : 2.45 GHz  $\pm$  25 MHz  
Power Output : 2100 W  
Quartz Tube : 25 mm OD x 21 mm ID x 500 mm Length  
Working Temperature :  $\leq$  1100 °C continuous  
Heating Elements : SiC ring  
Heating Rate : 10 - 150 °C/min programmable  
Temperature Control Accuracy :  $\pm$  1 °C  
Vacuum Level : up to  $1 \cdot 10^{-5}$  torr by turbopump

## 9. Crystal Growth System

### 9.1. Bridgeman



#### Small Bridgman Crystal Growth Furnace - SKJ-BG-1600

Alumina Tube Dimensions : 60 mm OD  
Heating Zone Length : 200 mm  
Working Temperature :  $\leq 1600$  °C Continuous  
Heating rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 0.5$  °C  
Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump,  $1 \cdot 10^{-5}$  torr by turbomolecular pump  
Travel Distance : 200 mm  
Pulling Speed : 0.03 mm/hour - 30 mm/hour (adjustable, with an accuracy of  $\pm 1$   $\mu$ m)

### 9.2 Czochralski (CZ method)



#### Czochralski Crystal Growth System up to 2100°C - SKJ-50CZ

Chamber Size : 500 mm  $\Phi$  x 700 mm Height  
Working Temperature :  $\leq 2100$  °C with induction heating  
Vacuum Level :  $\leq 3.75 \cdot 10^{-5}$  torr  
Water cooling jacket and crystal seed rod  
Travel Distance : 200 mm  
Pulling Speed : 0.03 - 30 mm/hour  
Rotation Speed : 1 - 60 RPM  
Weighting System Capacity : 5000 g  
Weighting System Accuracy :  $\pm 0.1$  g

### 9.3 Flux/Solution Growth



#### 3-Zone Top Seeded Solution Growth (TSSG) Furnace - VTF-1200X-III-TSSG

Chamber size : 135 mm  $\Phi$  x 600 mm Height (3 zones: 150 mm + 300 mm + 150 mm with independent temperature control)  
Working Temperature : max. 1100 °C < 1 hour ; Continuous : max. 1100 °C  
Temperature Control Accuracy :  $\pm 0.1$  °C  
Travel Distance : 300 mm  
Pulling Speed : 0.5 - 50 mm/hour  
Rotation Speed : 0.1 - 23 RPM  
Maximum Load : < 2 kg

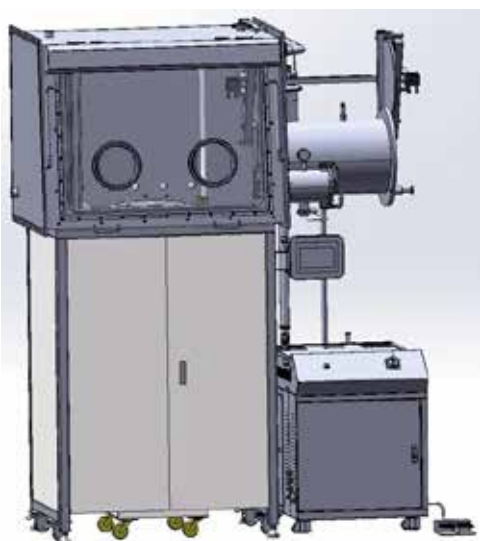
## 9. Crystal Growth System

### 9.4 Liquid Phase Epitaxial



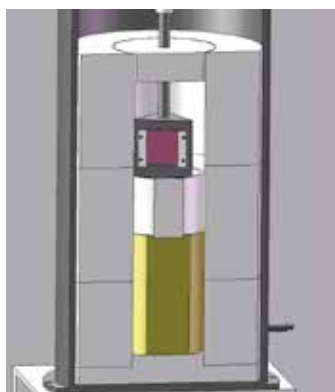
#### Liquid Phase Epitaxial Crystal Growth Furnace - VBF-1700-LPE

Chamber Size : 300 mm  $\Phi$  x 210 mm Height  
Working Temperature : max 1700 °C < 1hour ; Continuous : max. 1600°C (Bottom & side around heating)  
Heating Rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 0.1$  °C  
Travel Distance : 320 mm  
Pulling Speed : 0.03 – 30 mm/hour  
Rotation Speed : 0 – 100 RPM



#### Liquide Phase Epitaxy Grystal Growth Furnace with Glove-Box System – HP1100X-LPEGB

Vertical Heating Zone : 150 mm + 200 mm + 150 mm (3-Zone with independent control)  
Working Temperature : max. 1100 °C < 1 hour; Continuous : max. 1000 °C  
Heating Rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 0.1$  °C  
Travel Distance : 100 mm  
Pulling Speed : 0.05 – 10 mm/hour  
Pulling Rotation Speed : 1 – 10 RPM  
Max. Substrate Size : 60 mm x 60 mm  
Max. Substrate Number : 3 pcs



High Pressure Chamber Dimensions : 370 mm OD x 350 mm ID x 1200 mm  
Max. Pressure : 1.2 MPa under 700 °C  
Pressure Control Accuracy :  $\pm 1$  %  
Vacuum Level :  $4 \cdot 10^{-1}$  Pa with mechanical pump (no load)  
Glove-Box Chamber Dimensions : 1200 mm Length x 800 mm Width x 1200 mm Height

# 10. Melting and Casting

## 10.1 Electric Melting

### High Vacuum Melting-Casting Furnace - VMC-1200

Stainless Steel Vacuum Chamber : 315 mm  $\Phi$  x 315 mm Height  
Working Temperature :  $\leq 1200$  °C  
Temperature Control Accuracy :  $\pm 1$  °C  
Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump,  $2 \cdot 10^{-5}$  torr by 67 L/s turbomolecular pump,  $1 \cdot 10^{-6}$  torr by 260 L/s turbomolecular pump  
Possible to work under positive pressure with inert gas



## 10.2 Arc Melting



### Mini Arc Melter with 4 Cavities and Tube Seal - SP-MSM130

Quartz Chamber : 180 mm OD x 168 mm ID x 150 mm Height  
Water-cooled copper hearth with 4 cavities (8 g/cavities), up to  $\leq 3500$  °C  
Arc Melting Current :  $\leq 17$  A @ 240 V  
Continuous Melting Time :  $\leq 30$  s  
Vacuum Level :  $1 \cdot 10^{-5}$  torr by turbomolecular pump  
Tungsten Electrode Gun : 4 mm  $\Phi$   
Glovebox Compatible  
Optional : Additional parts need to be added for ambient conditions



### 32-Station Automatic Arc Melting System - SP-MSM360

32 samples in a single batch, up to  $\leq 3000$  °C  
Water-cooled one 32-cavity copper crucibles, 25 mm  $\Phi$  x 8 mm Depth  
Glove Box : 1200 mm x 740 mm x 900 mm.  
Purification System :  $H_2O$  and  $O_2$   $< 1$  ppm (20 °C, 1 atmosphere)  
4 mm  $\Phi$  tungsten electrode with water cooling  
Arc Melting Current :  $\leq 34$  A; Recommend power source breaker  $\geq 40$  A  
Stirring motion possible for uniform melting

### 10.3. Induction Melting



#### Induction Heating System - SP-85KTC

Quartz Chamber : 216 mm OD x 208 mm ID x 500 mm Length  
High Purity Graphite Crucible : 114 mm OD x 100 mm ID x 142 mm Height  
Working Voltage : 220 V AC, 50/60 Hz, 3 Phases (380 V AC, 3 phases available upon request)  
Working Current : 5 – 52 A (60 A breaker required)  
Input Power :  $\leq 15$  kW  
Output Frequency : 30 – 80 kHz  
Working Temperature : max. 2000°C < 1 hour;  
Continuous : 1000 °C -1900 °C  
Melting capability :  $\leq 4$  kg for Iron (tested)  
One Vacuum Pump Included :  $1 \cdot 10^{-2}$  torr



#### Desktop Induction Heater with Timer Control - SP-35AB

Working Voltage : 380 V AC, 50/60 Hz, 3 Phases  
Input Power :  $\leq 35$  kW  
Output Frequency : 30 – 80 kHz  
100% continuously working in 24 hours  
Automatic timer control or manual control selectable  
Water cooling and Induction coil available upon request

### 10.4. Levitation Melting



#### Vacuum Levitation Melting Furnace with Magnetic Stirring Function - FMF-65

Copper Cold Crucible Dimensions : 50 mm ID x 100 mm Depth  
Copper Cold Crucible : made up of 16 water-cooled segments  
Max. Load : 250 g Ti, 140 g Fe  
Working Voltage : 220 V AC, 50/60 Hz, 3 phases  
Output Power :  $\leq 65$  kW  
Output Frequency : 20 – 50 kHz  
Working Temperature :  $\leq 1800$  °C  
Temperature Measurement : Infrared Pyrometer  
Vacuum Level :  $6.67 \cdot 10^{-4}$  Pa (at RT, no load)

### 10.5. Ultrasonic Melting And Atomizing



#### Compact Ultrasonic Melting Atomizing System for Alloys - IMCS-700-LM

Stainless Steel Collection Chamber : 460 mm  $\Phi$  x 360 mm Height  
Stainless Steel Crucible : 115 mm  $\Phi$  x 150 mm Height  
Working Voltage : 208 – 240 V AC, 50/60 Hz, Single-Phase  
Input Power :  $\leq 1500$  W  
Output Frequency :  $\leq 20$  kHz  
Working Temperature : max. 700 °C < 0.5 hour, Continuous : max. 500 °C  
Typical Collection Rate (Sn as an example) : 150 mesh (<100  $\mu$ m): ~ 75%; 250 mesh (< 60  $\mu$ m): ~ 70%

# 11. Top/Bottom Loading



## Vertical Crucible Furnace - VBF-1200X-300

Chamber Size : 320 mm  $\Phi$  x 280 mm Height  
Working Temperature : max. 1200 °C  $\leq$  0.5 hour; Continuous:  
max. 1100 °C  
Heating Rate :  $\leq$  10 °C /min  
Temperature Control Accuracy :  $\pm$  1 °C  
Excellent uniformity and energy efficiency



## 3-Zone Heated Bottom Loading Box Furnace - VBF-1600X-L72

Chamber Size : 400 mm Length x 400 mm Width x 450 mm Height  
Working Temperature : max. 1700 °C < 1 hour; Continuous :  
max. 1600 °C  
Heating Rate :  $\leq$  10 °C/min  
Temperature Control Accuracy :  $\pm$  0.1 °C  
Electric Bottom Loading Station : 390 mm x 390 mm with 100 kg max.



## Vertical Split Tube Furnace - OTF-1700X-VT

Mullite Tube Dimensions : 60 mm OD x 54 mm ID x 1000 mm Length  
Heating-Zone Length : 400 mm  
Working Temperature :  $\leq$  1600 °C  
Heating Rate :  $\leq$  10 °C/min for 0 - 1400°C,  $\leq$  5 °C/min for 1400 - 1600°C  
Temperature Control Accuracy :  $\pm$  1 °C  
Vacuum Level :  $1 \cdot 10^{-2}$  torr by mechanical pump,  $1 \cdot 10^{-5}$  torr by turbomolecular pump

## 12.1. Liquid Quenching



### Vacuum and Atmosphere Controlled Quenching Tube Furnace - GSL-1700X-60-VTQ

99% High Purity Alumina Tube : 60 mm OD x 54 mm ID x 850 mm Length  
Heating Zone Length: 130 mm  
Working Temperature : max. 1700 °C < 1 hour; Continuous : 800 - 1600 °C  
Heating Rate :  
< 2°C/min for  $T \geq 1400^{\circ}\text{C}$ ;  
< 5°C/min for  $T \in [1200, 1400]^{\circ}\text{C}$ ;  
< 10°C/min for  $T \leq 1200^{\circ}\text{C}$   
Temperature Control Accuracy :  $\pm 1^{\circ}\text{C}$   
Full automatic electromagnet sample release flange  
Stainless steel tank for quenching liquid

## 12.2. Gas Quenching



### Bottom-loading Vacuum Furnace with Rapid Cooling - VBF-1200X-E8

Quartz Chamber Size : 230 mm OD x 218 mm ID x 340 mm Height  
Working Temperature :  $\leq 1000^{\circ}\text{C}$  continuous under vacuum ;  $\leq 1200^{\circ}\text{C}$  with inert gas  
Heating Rate :  $\leq 20^{\circ}\text{C}/\text{min}$   
Temperature Control Accuracy :  $\pm 1^{\circ}\text{C}$   
Water-cooled vacuum flange  
Built-in Gas Cooling System: 4 gas blow tubes for faster cooling of heated sample

## 13. Rotary & Rocking

### 13.1. Rotary Tube



#### Dual Zone Rotary Tube Furnace - OTF-1500X-II-R60

Alumina Tube Size : 60 mm OD x 54 mm ID x 1200 mm Length  
Working Temperature : max. 1500 °C < 1 hour ; Continuous : max. 1400 °C  
Temperature Control Accuracy :  $\pm 1$  °C  
Maximum Vacuum level :  $4.5 \cdot 10^{-2}$  torr  
Furnace Tilt Angle :  $-5 - 20$  °  
Tube Rotating Speed : 0 – 7 RPM  
Optional : Continuous Powder Feeding & Retrieving System

### 13.2. Rocking Tube



#### Rocking Tube Furnace - GSL-1700X-RC

99.5 % High Purity Alumina Tube Dimensions : 60 mm OD x 54 mm ID x 800 mm Length  
Heating Zone Length : 300 mm  
Working Temperature : max. 1700 °C < 2 hours ; Continuous : max. 1600 °C  
Heating Rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C  
Rocking Angle :  $\pm 45$  ° max. adjustable (90 ° is available upon request)  
Rocking Frequency : 0.1 – 1 time/min adjustable  
Vacuum Level :  $0.5 \cdot 10^{-2}$  torr by a mechanical pump,  $1 \cdot 10^{-5}$  torr by turbomolecular pump

## 14. Automated Furnace



### Automated Box Furnace - KSL-1200X-M-AD

Chamber Size : 300 mm Length x 300 mm Width x 300 mm Height

Working Temperature : max. 1200 °C < 1 hour ; Continuous : max. 1100 °C

Heating Rate :  $\leq 10$  °C/min

Temperature Control Accuracy :  $\pm 1$  °C ( Optional Accuracy  $\pm 0.1$  °C upon request)

Automatic Operation : Door closing, temperature raising, dwelling, and cooling, and door opening

1 PC can control up to 8 furnaces simultaneously

Option: Automation Collaborative Robot for sample loading



### Automated Tube Furnace for AI Material Research - OTF-1200XS6-ASD

Quartz Tube Dimensions : 150 mm ID x 600 mm Length

Working Temperature : < 1100 °C

Heating Rate :  $\leq 10$  °C/min

Temperature Control Accuracy :  $\pm 1$  °C

Crucible Holder : made of quartz, with 4 holes to carry 4 quartz crucibles

Quartz Crucibles : 40 mm  $\Phi$  x 30 mm Height

Option: Automation Collaborative Robot for sample loading (see MTI-MG400)

# 15. High Throughput

## 15.1. Multiple Channels



### Hi-Throughput 4 Channel Box Furnace KSL-1500X-MGI-4

Each Chamber Dimensions : 120 mm Length x 120 mm Width x 120 mm Height  
4 independent temperature control channels  
Working Temperature : max. 1400 °C < 0.5 hour ; Continuous : max. 1300 °C  
Heating Rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C



### 10 Channel Tube Furnace for Hi-Throughput Annealing - GSL-1700X-MGI-10

10 Alumina Tubes With Size : 25 mm OD x 460 mm Length  
10 independent heating control channels  
Working Temperature : max. 1700 °C < 1 hour; Continuous : max. 1600 °C  
Heating Rate :  $\leq 10$  °C/min  
Temperature Control Accuracy :  $\pm 1$  °C ( Optional Accuracy  $\pm 0.1$  °C upon request)  
Vacuum Level :  $1 \cdot 10^{-3}$  torr by a mechanical pump;  $1 \cdot 10^{-5}$  torr by a turbomolecular pump

## 15.2. Automated Loading



### Desktop Collaborative Robot - MTI-MG400

Axes : 4  
Payload : 500 g  
Working Radius : 440 mm  
Positioning Accuracy :  $\pm 0.05$  mm  
Automated sample loading and unloading

# Appendix: Abbreviations

- **CVD** : Chemical Vapor Deposition
- **RTP** : Rapid Thermal Processing
- **IR** : Infrared
- **CZ method** : Czochralski method
- **OD** : Outside Diameter
- **ID** : Interior Diameter
- **RF** : Radio Frequency
- **DVD** : Direct Vaporizing Deposition
- **HPCVD** : Hybrid Physical-chemical Vapor Deposition
- **SCCM** : Standard Cubic Centimeters per Minute
- **Φ** : Diameter
- **LEL** : Lower Explosive Limit
- **RT** : Room Temperature
- **pcs** : piece
- **min** : minute



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