

# Tetra Arc Furnace for Crystal Growth

Manufactured by GES Corporation



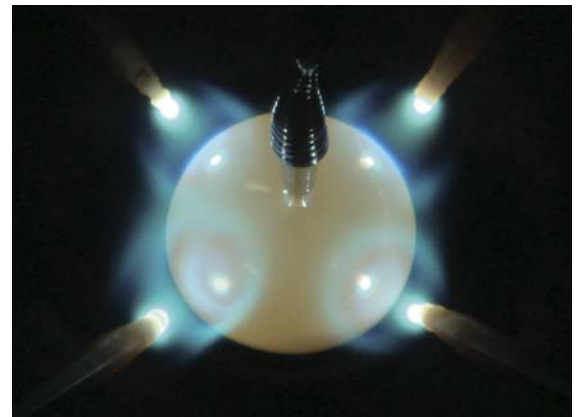
## Features

- Single crystal growth by Czochralski pulling method
- Four electric arcs discharged in Ar gas to melt material up to 3000°C
- $10^{-6}$  Torr vacuum within one hour to achieve high Ar gas purity
- Convenient handling of material and furnace
- Easy operation from control panel
- Real time monitoring of crystallization process

## Capable of growing

Metallic-conductive materials:

- Metal compounds
- High temperature superconductors

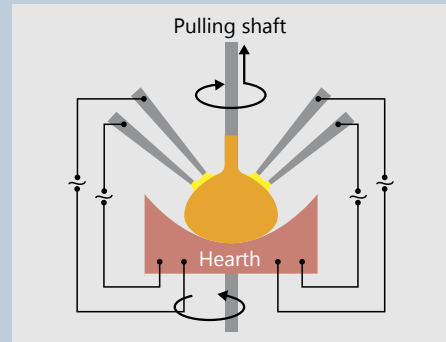


Single crystal of  $\text{CeRh}_2\text{Si}_2$  (cerium, rhodium, silicon). Photo by GES

# Special Features

## System principle for crystal growth

- Material, on rotated hearth, melted by 4 electric arcs discharged in Ar gas
- Material pulled for gradual cooling for single crystallization by pulling shaft (Czochralski pulling method)



## System composition

- Furnace unit
  - 4 arc electrodes
  - Pulling shaft
  - Hearth
  - Vacuum system
  - Ti getter
- Control unit
- Power supply unit
  - System control line
  - Arc generators



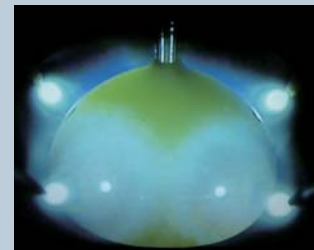
## 4 ( Tetra ) arcs

- 4x total arc power to melt material
- Uniform arc power by 4 arcs
- Easy control of arc power via control unit
- Direct manual control of arc position via arc electrode from outside of furnace



## Real time monitoring

- Via CCD camera to check melting and pulling process to adjust arc power



# Special Features

## Convenient handling of furnace

- 4 monitoring windows ( top / front / sides ) of furnace
- Monitoring windows can open for sample placement and cleaning
- Top cover of furnace can be opened for easy maintenance and cleaning



## Excellent vacuum system

- $10^{-6}$  Torr ( within 1 hour )
- Turbo molecule pump ( 220L/sec ) directly connected to large 4" gate valve of furnace to maximize conductance
- $< 1 \times 10^{-9}$  atm. cc/sec vacuum leak rate



TMP directly connected to 4" gate valve

## Easy control via control unit

- Crystal growth parameters
  - Arc power control ( each arc separately or all arcs at one time )
  - Hearth rotation
  - Pulling shaft rotation and pulling speed
- Vacuum pump control
- Malfunction alarm



4 arc power volume

# Specifications

Furnace	Material and structure	Stainless steel ( double walled + cooling water )
	Windows	Monitoring windows ( top / front / side ) open for sample placement and cleaning
	Working pressure range	$5 \times 10^{-6}$ Torr ~ 1.1Atm
	Vacuum discharge system	$10^{-6}$ Torr ( within 1 hour ), turbo molecule pump : 220L/sec + rotary pump : 100L/min
	Vacuum gage	Measurement range : 760 Torr ~ $1 \times 10^{-9}$ Torr
	Main valve	4" gate valve ( manual )
	Arc electrode / shaft	4 tungsten electrodes / stainless shafts ( water cooling )
	Getter electrode / shaft	1 tungsten electrode / stainless shaft ( water cooling )
Pulling shaft	Material and seal	Stainless / ferro-fluidic seal+bellows ( water cooling )
	Pulling speed	0-39mm/hr +/- 1.0% at full scale ( servo-motor )
	Pulling stroke	150mm
	Rapid travel speed	100mm/min ( fixed speed )
	Rotation speed	0-10rpm
Hearth	Hearth material	Oxygen free copper ( water cooling )
	Shaft material and seal	Stainless / ferro-fluidic seal+bellows ( water cooling )
	Rotation speed	0-10rpm
	Travel stroke	20mm ( manual )
Control unit	Crystal growth parameters ( arc power, hearth rotation, shaft pulling and rotation ), vacuum control, malfunction alarms	
Power supply unit	System control lines, four arc generators ( for four arc electrodes ), getter generator, transformer	
Monitor	Real time crystal growing monitor via CCD	
Size ( W x D x H )	Furnace unit: 1400 x 750 x 1200 (mm) Control unit: 600 x 550 x 1000 (mm) Power supply unit: 1400 x 750 x 1200 (mm)	
Weight	Furnace unit: 380kg Control unit: 120kg Power supply unit: 600kg	
Power requirement	190-460VAC 50-60Hz (20KVA), 3-phase, 4 wires + ground	
Cooling water requirement	15L/min, pressure 0.3~0.5MPa, temperature <25°C	