



JYT Corp, Beijing, China
Phone: +86-10-80803017
Fax: +86-10-80803017
Web: www.jytcorp.com

Represented by



VacSol GmbH, Germany
Phone: +49 7025 895020
Fax: +49 7025 895021
Web: www.vacsol.com
Mail: info@vacsol.com

JRDL-900 Mono-Silicon Crystal Grower

1.1 Overview

JRDL-900 single crystal growing furnace is a flexible shaft single crystal pulling type under an environment of inert gases, which applies a graphite resistance heater to melt silicon semiconductors and produce dislocation free single crystals based on Czochralski technique. Moreover, the equipment is capable of producing high-quality single crystals for large-scale integrated circuits and uses 22" 100kg to 120kg heating system charges to control 8" to 10" single crystals. It provides a pair of electrode to meet users' technique requirements to use two heating zones.

1.2 Technical Characteristics

The equipment adopts a flexible seed crystal shaft and has a unique seed crystal lifting mechanism to reduce the furnace height. Therefore, it can be installed and operated in common workshops, ensuring easy assembly, repair and crystal pulling and achieving a stable seed crystal shaft rotation speed.

JRDL-900 single crystal growing furnace has made further progress in terms of performance and control. Firstly, its mechanical structure has applied the advanced magnetofluid hermetic sealing technique, the novel flap valve structure, the arched head transition chamber structure, and the rational main and receiving chamber lifting mechanism. In consideration of thermal deformation of the main and the receiving chamber, the receiving chamber and transition chamber lifting is realized by a floating lifting mechanism to avoid seizures due to thermal deformation and depression deformation. Besides, single crystals are lifted by means of a flexible shaft weaved from stainless steel wires, which can bear 300kg.

A top open furnace chamber is provided. A hydraulic drive moves the main chamber and the receiving chamber upwards to open them. Once

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they reach to the designed position, they will be symmetrically unscrewed to ensure a stable and reliable host machine, easily and mechanically take out crystals, install and dismantle the heating field system and internally clean the furnace.

A floating flap valve is configured between the main chamber and the receiving chamber to take out crystals, replace seed crystals, replenish materials and continuously pull crystals while the heating field keeps the technique temperature.

Based on computer control, the electric control system (temperature control and crystal diameter control) has all-around functions, high precisions and great stabilities. Imported motor systems featuring stable and reliable performances are equipped for crucible lifting, crucible rotation, crystal lifting and crystal rotation. In addition, multi-wedge belts are used to transmit large torque and ensure stable and vibration-free actions.

The electric control has following characteristics:

- (1) Automatic temperature control system;
- (2) Motor speed adjusting control system;
- (3) Automatic single crystal diameter control system;
- (4) Automatic single crystal and fused mass tracking system;
- (5) Single crystal weight and growing length display function;
- (6) All items above are operated by programmable controllers.

Parameters, including rotation speed of seed crystal shaft and crucible shaft, crystal lifting and crucible lifting speed, furnace internal pressure and other data, are related to the crystal pulling and displayed by digital indicators to record temperature and seed crystal pulling speed. The entire system is capable of stably controlling dislocation free single crystals with 8" to 10" even diameter.

Various automatic interlocking and safety measures are available. See details below.

Cooling water temperature detection and excess temperature alarm of

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main parts, cooling water under-pressure alarm, seed crystal shaft and crucible shaft over-travel alarm and emergency manual crucible lifting mechanism; overcurrent protection, limiting and interlocking of the main chamber and the receiving chamber.

The electric control cabinet is configured with a main control cabinet and a power output chamber. Wherein, the main control cabinet mainly attains various controls, operations and parameter displays. Programmable controllers are applied to the whole cabinet. The power output cabinet mainly provides heating powers.

In addition, the host machine is configured with a maintenance platform for the convenience of debugging and repair.

1.3 Main Technical Specifications

No	Name	Specification
1	Model	JRDL-900IRCON/CCD
2	Product Name	Mono-crystal Grower
3	Power Voltage	380V
4	Power Frequency	50Hz
5	Power Phase	3 PHASE
6	Heating Method and Heating System	Resistivity heating and graphite heater
7	Main Transformer Capacity	250KVA
8	Main Heater Power	180KW
9	Main Heater Maximum Heating Voltage	60V
10	Whole Power Supply	≤190KW
11	Maximum Temperature Inside Main Chamber	1600°C
12	Vacuum Level at Normal Condition	<3Pa
13	Leak Rate of Chamber at no Heating Condition	<1Pa/5min
14	Vacuum Level at Main Chamber When the Pulling Chamber Open	<3Pa
15	Diameter Range of Ingot	8"— 10"
16	Accuracy of Diameter	IRCON ±2.5mm/CCD ±1mm
17	Charge Capacity	100kg ~ 120kg
18	Raw Material	Multi-crystal silicon
19	Ingot Length	≥1000mm (8")
20	Time for One Run	≈40h
21	Main Chamber Size	Φ900×1250mm

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22	Middle Chamber Size	Φ900×850mm
23	Lower Chamber Size	Φ900×400mm
24	Throat Diameter	Φ300
25	Pulling Chamber Size	Φ298×2500mm
26	Distance Between Electrodes	480mm
27	Vacuum Pump Model	For the minor chamber is TRP-24vacuum pump;For the main chamber is 2H-70 rotary pump
28	Seed Pull Speed Range	0.1—10mm/min
29	Seed Jog Speed	≥160mm/min
30	Seed Rotation Speed Range	2—40rpm
31	Crucible Lift Rate	0.02—1mm/min
32	Crucible Rotation Speed Range	1—30rpm
33	Total Crucible Travel	≥350mm
34	Total Seed Travel Inside Pulling Chamber	1650mm
35	Maximum Temperature for Coolant Water at exit point	Maximum temperature for coolant water is 40 °CAlarm flashes at temperature of 50°C
36	Total Height of the Grower	6800mm
37	Workshop Height	>8000mm
38	Weight of Gower	≈4500kg
39	Footprint of Grower	3100mm×2300mm
40	Required Area for the Grower	5300mm×3300mm
41	Vibration Isolation Groove Requirement	Vibration prove ditch is required between the main chamber and vacuum pump with a distance of more than 3M
42	Distance between Growers	≈2m
43	Pressure and Volume of Coolant Water	Pressure 0.15—0.2Mpa , volume 20 m ³ /h
44	Coolant Water Consumption/Run	≥15m ³ /h
45	Coolant Water Temperature	<25°C
46	Argon Consumption/Run	3000L/h

1.4 Accessories:

- (1) All accessories of the equipment include a host machine, a power control cabinet, a main vacuum pump unit and an auxiliary vacuum pump unit.
- (2) Standby crystal diameter measuring instrument to measure crystal diameters. Users can optionally buy it.
- (3) Crucible and heating system: To fix price additionally based on users' need.

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