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JRDL-800 Mono-Silicon Crystal Grower

1.1 Overview

JRDL-800 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 18" 60kg heating system charges to control 6" to 8" 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-800 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

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main chamber and the receiving chamber upwards to open them. Once 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 6" to 8" even diameter.

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

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Cooling water temperature detection and excess temperature alarm of 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 | Item | Specification |
|----|----------------------------------------------------------|-----------------------------------------|
| 1 | Model | JRDL-800IRCON/CCD |
| 2 | Product Name | Mono-Silicon Crystal Grower |
| 3 | Power Voltage | 380V |
| 4 | Power Frequency | 50Hz |
| 5 | Power Phase | 3 phases |
| 6 | Heating Method and Heating System | Resistivity heating and graphite heater |
| 7 | Main Transformer Capacity | 190KVA |
| 8 | Main Heater Power | 140KW |
| 9 | Main Heater Maximum Heating Voltage | 60V |
| 10 | Whole Power Supply | ≤150KW |
| 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 Minor Chamber Open | <3Pa |
| 15 | Diameter Range of Ingot | 6"— 8" |
| 16 | Accuracy of Diameter | IRCON ±2.5mm / CCD ±1mm |
| 17 | Charge Capacity | 60kg |
| 18 | Raw Material | Multi-crystal silicon |
| 19 | Ingot Length | ≥1000 mm (6") |

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| | | |
|----|-----------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| 20 | Time for One Run | ≈30h |
| 21 | Main Chamber Size | Φ800×1150mm |
| 22 | Middle Chamber Size | Φ800×800mm |
| 23 | Lower Chamber Size | Φ800×350mm |
| 24 | Throat Diameter | Φ260 |
| 25 | Receiving Chamber Size | Φ260×2220mm |
| 26 | Distance Between Electrodes | 436mm |
| 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 | 1400mm |
| 35 | Maximum Temperature for Coolant Water at exit point | Maximum temperature for coolant water is 40 °C, alarm flashes at temperature of 50°C |
| 36 | Total Height of the Grower | 6360mm |
| 37 | Workshop Height | >7600mm |
| 38 | Weight of Gower | ≈4000kg |
| 39 | Footprint of Grower | 2800mm×2000mm |
| 40 | Required Area for the Grower | 5000mm×3000mm |
| 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/Unit | ≥15m ³ /h |
| 45 | Coolant Water Temperature | <25°C |
| 46 | Argon Consumption/Unit | 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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