

# PRESENTATION

on

## Silicon Metal and UMG Silicon Materials Producing and Controlling



**SINOSI**



*The World of Silica & Silicon*

**SINOSI GROUP CORPORATION**

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## 1. Profile

Sinosi Group Corporation (hereinafter referred to as SINOSI or Company) is a leading producer and supplier of silica and silicon materials and related products in China and cover the world wide market. We now have been serving customers from more than 60 countries and regions with 30 categories of products totaling more than 500 types.

The silicon materials such as silicon metal, silicon metal powder, silicon carbon powder, UMG silicon, solar grade polysilicon and monosilicon are the main scope of our business in the silica and silicon industry field. This materials are widely used in the aluminum, steel, chemicals and the photovoltaic industry in the worldwide.

Meanwhile, the design, equipment producing and system providing for producing of silica and silicon materials especially for the silicon metal, UMG silicon and solar grade polysilicon materials now become one of our main business since 2005.

## 2. Facilities

Some of our facilities and assets for the silicon materials include:

- | Standard silicon metal production;
- | High purity silicon metal such as 2N, 3N, 4N and 5N production;
- | Solar grade polysilicon chunk, brick, ingot and wafer production;
- | High purity quartz materials (HPQ series) production;
- | Silicon carbide powder production;
- | Spherical fused silica powder production;
- | Electric arc furnace and related fittings producing and supplying;
- | Silica and silicon purification, processing and treatment equipment supplying;
- | Environmental protection system design and supplying.

## 3. Product Offering and Main Specifications

### 3.1. Standard Silicon Metal

Standard Silicon Metal				
Item and Grade	Chemical Components (%)			
	Si (min.)	Impurity (max.)		
		Fe	Al	Ca
1101	99.50	0.10	0.10	0.01
2202	99.40	0.20	0.20	0.02
3303	99.30	0.30	0.30	0.03
421	99.00	0.40	0.20	0.10
441	99.00	0.40	0.40	0.10
553	98.50	0.50	0.50	0.30

### 3.2. 3N Purity Silicon Metal

3N High Purity Low-B Low-P Silicon Metal Specifications			
Purity (%)	Impurity (%)		
Si	Fe	Al	Ca
99.92	0.025	0.012	0.0002

### 3.3. 4N UMG Silicon Chunks

4N High Purity Low-B Low-P Silicon Metal Specifications					
Chemical Components: Si: 4N (99.99%) min.		Resistivity (typical data): 0.1~0.3 ohm.cm		Size: 5-200mm	
Impurities (typical data, reference only):					
Element	Percentage (%wt)	Element	Percentage (%wt)	Element	Percentage (%wt)
Al	<0.0002	Cu	<0.0001	Pb	<0.0001
B	<0.0003	Fe	<0.0014	Sb	<0.0001
Bi	<0.0001	Mg	<0.0001	Sn	<0.0001
Ca	<0.0002	Mn	<0.0001	Ti	<0.0001
Cd	<0.0001	Mo	<0.0001	V	<0.0001
Co	<0.0001	Ni	<0.0001	Zn	<0.0001
Cr	<0.0001	P	<0.0010		

### 3.4. 5N UMG Silicon Chunks

5N Polysilicon Specifications		
Chemical Components: Si: 5N (99.999%) min.	Resistivity (typical data): Type A: 0.5-3.0 ohm.cm Type B: 0.2-1.0 ohm.cm	Size: 5-200mm

## Impurities (typical data, reference only):

Element	Percentage (%wt)	Element	Percentage (%wt)
Al	<0.0002	Mn	<0.0001
B	<0.00012	Mo	<0.0001
Bi	<0.0001	Ni	<0.0001
Ca	<0.0001	P	<0.0003
Cd	<0.0001	Pb	<0.0001
Co	<0.0001	Sb	<0.0001
Cr	<0.0001	Sn	<0.0001
Cu	<0.0001	Ti	<0.0001
Fe	<0.0001	V	<0.0001
Mg	<0.0001	Zn	<0.0001

### 3.5. 6N Polysilicon Chunks

#### 6N Polysilicon Specifications

Item	Unit	Parameter	Testing/Analysis Method
P-type Resistivity	(ohm.cm)	200-500	KDY-2 Resistivity/Resistance Meter
Boron	ppba	0.5-1.2	LT-FTIR
N-type Resistivity	Ohm.cm	2-25	KDY-2 Resistivity/Resistance Meter
Donor	ppba	3	LT-FTIR; ICP-MS
N-type minority electron carrier lifetime	uS	100 min.	LT-IC Lifetime Tester
Carbon content	at/cm <sup>3</sup>	0.5x10 <sup>16</sup> max.	FTIR
Oxygen content	at/cm <sup>3</sup>	1.0x10 <sup>17</sup> max.	FTIR
Total metal impurity (Fe, Cr, Ni, Cu, Zn, Na, K, Ca)	ppmw	0.05-0.5 max.	ICP-MS
Status	Surface	Grey, Luster free, rough	Visual observation
	Section	Oxidized layer free	Optical microscope

## 4. Operations

### 4.1. Silicon Metal Production

Silicon metal production at Sinosi begins with high-purity silica ore mined from SINOSI Group's wholly-owned ore field in China. By having higher purity ore in the first place, our silicon metal products are very

competitive in terms of impurities. The scale of our silicon metal smelting operation also allows us to price our silicon metal products at an attractive level.



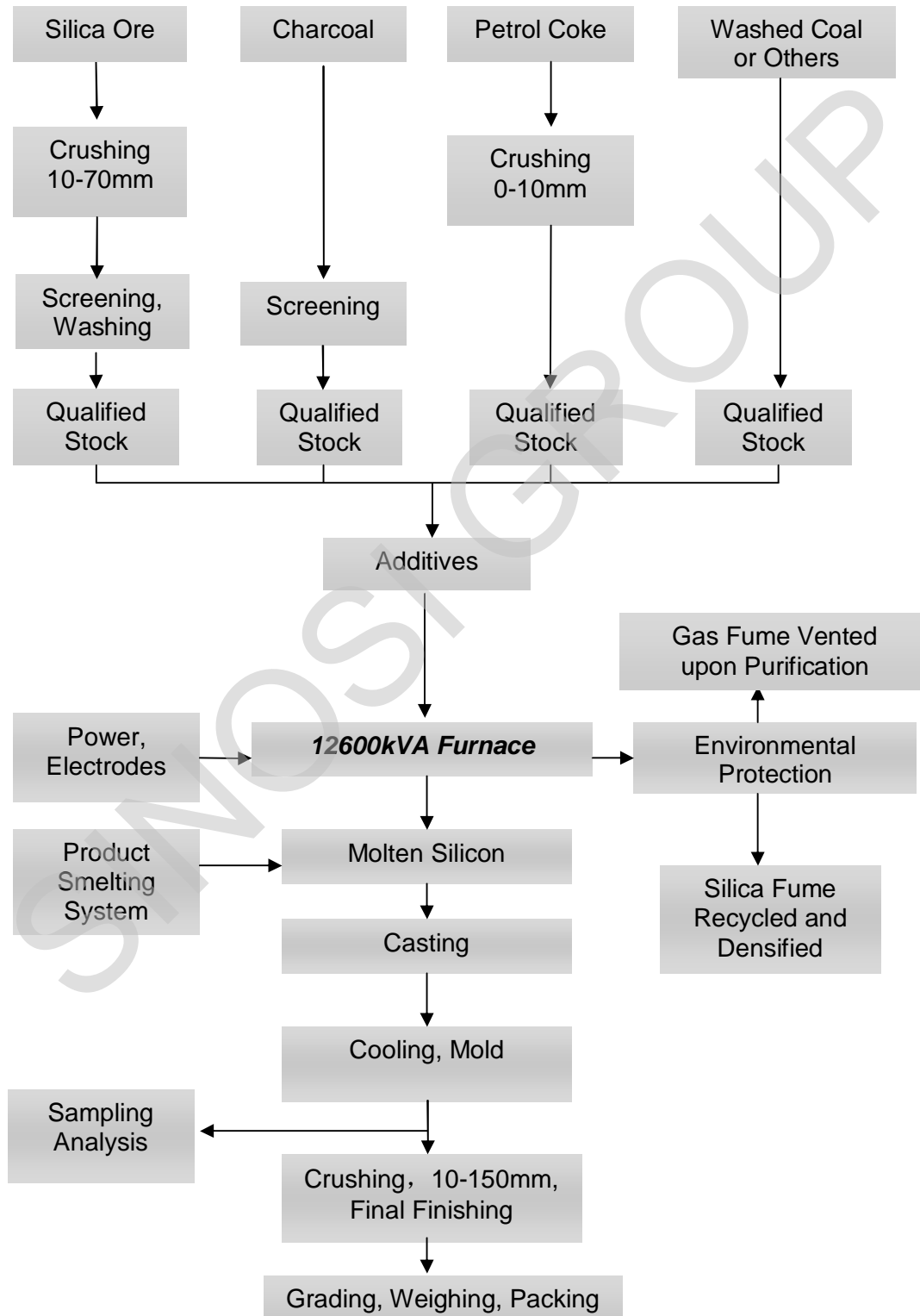
#### 4.2. UMG Silicon Production

Our proprietary UMG silicon production system is capable of producing 1,500 tons of UMG polysilicon chunks per year. Manufactured using high standard materials, our systems are equipped with quality accessory parts and components. Since we manufacture polysilicon from our own silicon materials, efficiency in our operation means a more competitive cost compared to other suppliers.

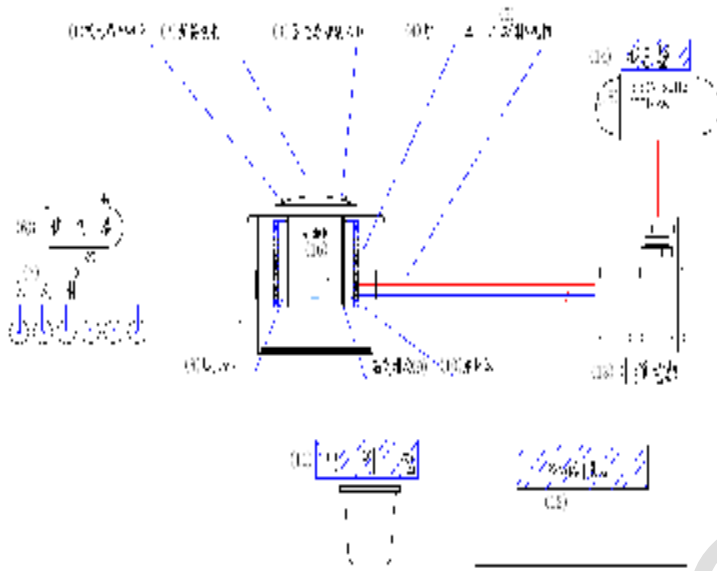


## 5. Production Process

### 5.1. Silicon Metal



## 5.2. UMG Silicon Materials

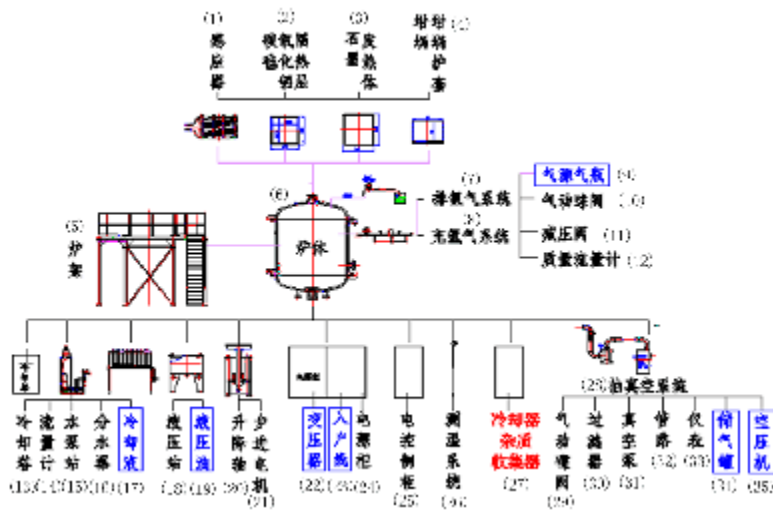


### **Slag-making and Purification Equipment**

#### **Illustration**

- (1) Gaseous additive intake
- (2) Furnace cover mechanism
- (3) Solid additive intake
- (4) Furnace body
- (5) Rocker tilt
- (6) Gas storage tank
- (7) Bus-bar wire
- (8) Heat insulating material
- (9) Quartz crucible
- (10) Heating Unit
- (11) Ladle
- (12) Circulation cooling pumping station
- (13) Intermediate frequency power source
- (14) Transformer
- (15) 380v 50Hz 630KvA
- (16) Molten silicon liquid level





### Illustration of High Temperature High Vacuum Gaseous Phase Impurity-Removing Equipment

- (1) Inductor
- (2) carbon felt alumina thermal barrier
- (3) graphite heating unit
- (4) crucible/crucible protective sheath
- (5) furnace stand
- (6) furnace body
- (7) argon exhaust system
- (8) argon intake system
- (9) gas bottle of source gas
- (10) pneumatic ball valve
- (11) pressure reducing valve
- (12) mass flowmeter
- (13) cooling tower
- (14) flowmeter
- (15) pumping station
- (16) water knockout drum
- (17) coolant
- (18) hydraulic pressure station
- (19) hydraulic fluid
- (20) lifting shaft
- (21) stepping motor
- (22) transformer
- (23) service wire
- (24) power cabinet
- (25) power distribution cabinet
- (26) thermometric system
- (27) Impurity collection device of cooling unit
- (28) pumped vacuum system
- (29) pneumatic disc valve
- (30) filter
- (31) vacuum pump
- (32) pipeline
- (33) instrument
- (34) gas storage tank
- (35) air compressor





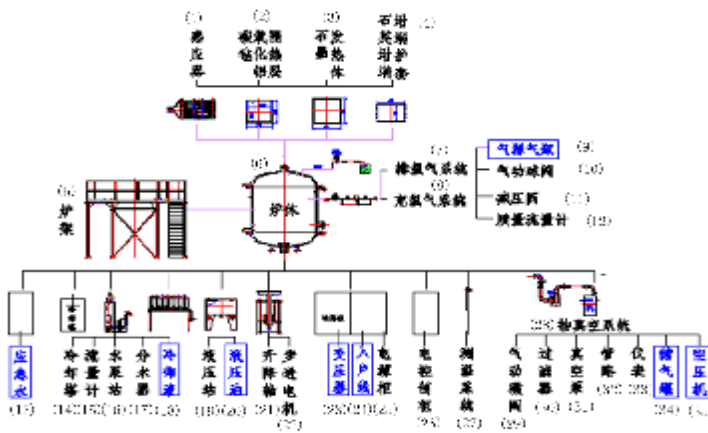


Illustration of Directional Solidification Equipment

- |   |                                 |
|---|---------------------------------|
| (1) Inductor                            | (18) hydraulic pressure station |
| (2) carbon felt alumina thermal barrier | (19) hydraulic fluid            |
| (3) graphite heating unit               | (20) lifting shaft              |
| (4) crucible/crucible protective sheath | (21) stepping motor             |
| (5) furnace stand                       | (22) transformer                |
| (6) furnace body                        | (23) service wire               |
| (7) argon exhaust system                | (24) power cabinet              |
| (8) argon intake system                 | (25) power distribution cabinet |
| (9) gas bottle of source gas            | (26) thermometric system        |
| (10) pneumatic ball valve               | (27) pumped vacuum system       |
| (11) pressure reducing valve            | (28) pneumatic disc valve       |
| (12) mass flowmeter                     | (29) filter                     |
| (13) emergency water storage tank       | (30) vacuum pump                |
| (14) cooling tower                      | (31) pipeline                   |
| (15) flowmeter                          | (32) instrument                 |
| (16) pumping station                    | (33) gas storage tank           |
| (17) water knockout drum coolant        | air compressor                  |

## 6. Quality Assurance

### 6.1. Material Control

#### - Silica Ore:

We use high purity silica ore from our quartz mine in Kazakhstan as feedstock. These silica ores have high SiO<sub>2</sub> purity and are low in Fe, Al, Ca and other impurities.

#### - Reductants:

Instead of traditional charcoal, we source high standard coal and petrol-coke from the most qualified suppliers to be used as the reductant material, and adopt an improved production process of silicon metal by leveraging our expert know-how. The materials must be of low ash and high volatility.

## 6.2. Technology Control

We employ continuous improvement practices on our smelting technology. We also have flexible control over production according to buyer's desired specification. When producing certain high purity grades for instance, the proportion of coke, petrol-coke, charcoal and wood chips will be adjusted and sometimes using entirely petro-coke in order to achieve required specification by maintaining low impurity levels of Fe, Al, Ca, P, B and so on.

## 6.3. Refining Control

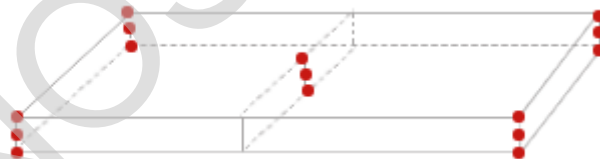
Before scraping the casting block, all slag will be removed by hand, and before packing all fine slag will be filtered out through a filtration device. These will be sold as by-product.

## 6.4. Testing Control

1) On each workday, all the materials that will be consumed on that day are separately inspected. The inspection records will be filed.

2) Sample will be drawn and tested from tap hole while molten silicon flows into the ladle. The testing records will be filed.

3) In the casting area, representative sample will be drawn from 15 spots on solid silicon block upon cooling. The testing results will be filed.



*Sampling spots*

4) After packing, samples will be drawn randomly from each bag to be inspected for relevant elements such as Si, Fe, Al, Ca and other impurities. All testing results of each bag will be filed by our lab at the same time that each bag is labeled with Silicon Grade, Bag Number, Batch/Casting Number and our testing report.

5) In accordance to relevant testing standards, CIQ/SGS or other inspection organizations will conduct authoritative inspection for each lot and issue testing reports per the user's request.

6) Before loading, each lot will be strictly inspected by our lab once again before issuing the Inspection Certificate or Testing Report as our final and official quality certificate to the user. The quality certificate shall include:

- Each bag's testing report issued by us
- Lot/Bag Number
- Gross/Net Weight

### 6.5. Logistics Control

To ensure on-time delivery, we have established reliable logistics channel for the delivery of the goods with highly qualified logistics service providers. Our logistics partner excels in aspects including storage, transportation, loading, discharging and other customer-specific requests. This partnership enables us to offer you quality performance at a competitive price.

### 6.6. Testing Instruments

We normally and mainly use the Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and Inductively Coupled Plasma Atomic Emission Spectrometry (ICP-AES) for the analysis and testing of the samples, but we also have the following instruments in our lab for testing and analysis available upon request:

- 1) Neutron Activation Analysis (NAA)
- 2) Atomic Absorption Spectrometry (AAS)
- 3) Atomic Fluorescence Spectrometry (AFS)
- 4) Molecular Spectroscopy (MS)
- 5) X-Ray Fluorescence Spectrometry (XRF)
- 6) Ion Chromatography (IC)
- 7) Polarography, Ion Selective Electrodes and Other Electro-Chemical Analysis Techniques

The approach and standard of the analysis and testing are normally arranged according to ASTM, ISO and GB standard per the samples and requests.

## 7. Contact Information

For more detailed information or make an enquiry, please contact us as per the following information:

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