硅碳棒

SIC Heating elements

硅化硅电热元件是选用优质绿色碳化硅为主要原料，经加工制还坯、高温硅化、再结晶而成的棒状非金属高温电热元件。该元件与金属电热元件相比，具有使用温度高、抗氧化、耐腐蚀、寿命长、变形微、安装维修方便等特点。因此它被广泛应用于磁性材料、粉末冶金、陶瓷、玻璃、冶金和机械等工业的多种高温电炉及其它电加热设备。

The silicon carbide heating element is a kind of non-metal high temperature electric heating element, It is made of selected super quality green silicon carbide as main material,which is made into blank,silicided under high temerature and re-crystallized. Compared with metal electric heating element,this kind of element is characterized by high-applied temperature, anti-oxidization,anti-corrosion,long service life, little deformation,easy installation and maintenance. Therefore, it is widely used in various high temperature electric furnaces and other electric heating devices, such as in the industries of magnet, ceramics,power metallurgy,glass,meallurgy and machinery,etc.

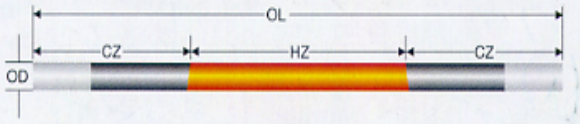
我们的碳化硅电热元件采用新的冷端部生产工艺，具有优良的热冷端电阻比，节能、寿命长，同时避免了因冷端部温度过高对炉体造成的损害。

We adopt new production process for cold ends, so our SiC heating elements have excellent specific rate of heat zone resistance and cold end resistance, saving energy,long life,avoiding over-temperature of cold ends to damage the furnace body.

碳化硅电热元件的产品型号

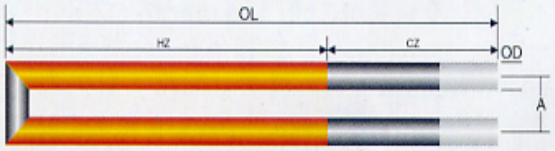
Specs and type of SiC heating elements

ED(直棒)型元件 ED (rod) type elements



型号Type:ED 外径：Outer diameter:OD,mm
发热部长度Hot zone length:HZ,mm
冷端长度Cold end length:CZ,mm
全长Overall length:OL,mm
例如Examples:
ED型Type,OD=54mm,HZ=1575mm
CZ=419mm OL=2413mm,Resistance 0.90Ω
表示为Specify as:
ED type,54/1575/2413/0.90Ω

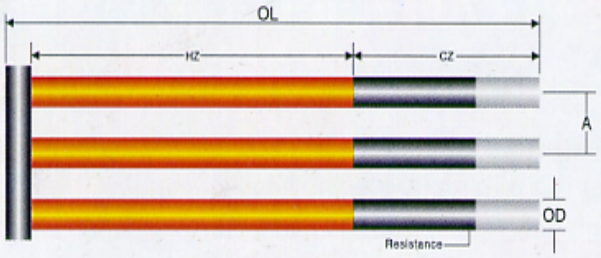
U型元件 U type elements



型号Type:U 外径：Outer diameter:OD,mm
发热部长度Hot zone length:HZ,mm
冷端长度Cold end length:CZ,mm
全长Overall length:OL,mm
间距Shank Spacing:A,mm
例如Examples:
U型Type,OD=20mm,HZ=300mm CZ=400mm
OL=700mm,A=60mm，Resistance 2.24Ω
表示为Specify as:
U type,20/300/700/60/2.24Ω

• W（三相）型元件

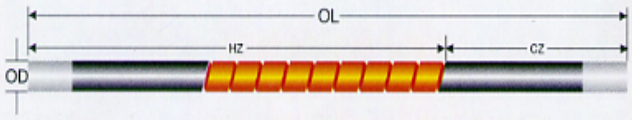
w（three phase）type elements



型号Type:W 外径：Outer diameter:OD,mm
发热部长度Hot zone length:HZ,mm
冷端长度Cold end length:CZ,mm
全长Overall length:OL,mm
间距Shank Spacing:A,mm
例如Examples:
W型Type,OD=52mm,HZ=250mm
CZ=350mm
OL=625mm,A=60mm，Resistance 0.90Ω
表示为Specify as:
W type,20/250/625/52/0.90Ω

SC（单螺纹）型元件

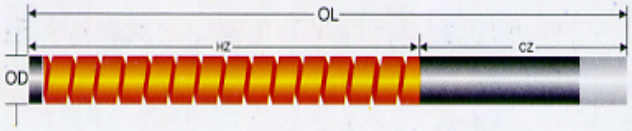
Sc（single spiral）type elements



型号Type:SC 外径：Outer diameter:OD,mm
发热部长度Hot zone length:HZ,mm
冷端长度Cold end length:CZ,mm
全长Overall length:OL,mm
间距Shank Spacing:A,mm
例如Examples:
SC型Type,OD=25mm,HZ=300mm
CZ=200mm OL=70mm,Resistance 1.59Ω
表示为Specify as:
SC type,25/300/700/1.59Ω

SCR（双螺纹）型元件

SCR（double spiral）type elements



型号Type:SCR 外径：Outer diameter:OD,mm
发热部长度Hot zone length:HZ,mm
冷端长度Cold end length:CZ,mm
全长Overall length:OL,mm
例如Examples:
SCR型Type,OD=31.7mm,HZ=305mm
CZ=241mm OL=546mm,Resistance 4.46Ω
表示为Specify as:
SCR type,31.7/305/546/4.46Ω

UX（槽）型元件

Ux（slot）type elements

型号Type:UX 外径：Outer diameter:OD,mm
发热部长度Hot zone length:HZ,mm
冷端长度Cold end length:CZ,mm
全长Overall length:OL,mm
例如Examples:
UX型Type,OD=30mm,HZ=400mm
CZ=300mm OL=700mm,Resistance 2.76Ω
表示为Specify as:
UX type,30/400/700/2.76Ω

碳化硅电热元件的物理性质 Physical property of elements

比重Specific gravity	2.6 ~ 2.8g/cm^3	抗折强度 Bend steghth	> 300kg
硬度Hardness	> 9MOH	抗拉强度 Tensile steghth	> 150kg/cm^3
气孔率Porosity rate	< 30%	辅射率 Radiancy	0.85

硅化硅电热元件的线膨胀系数、热传导率和比热等随着温度的变化而变化，相关数据如下：

The linear expansion coefficient,heat conductivity and specific heat of element will change along with temperature change.The relational data are as follws:

温度 temperature (℃)	线膨胀系数 linear expansion coefficien (10^{-6}m/℃)	热传导率 Heat conductivity	比热 Specific hea (Cal/g℃)
0	/		0.148
300	3.8		/
400	/		0.255
600	4.3		/
800	/		0.294
900	4.5		/
1100	/		/
1200	4.8		0.325
1300	/		/
1500	5.2		/

碳化硅电热元件的化学性质 Chemistry property of elements

1、元件的抗氧化性Antioxidant property of elements

元件在空气中使用到800℃时开始氧化，温度达到1000 ~ 1300℃时，发热部表面生成一层二氧化硅保护膜，1300度时结晶出立方石英，在1500℃时，保护膜达到一定的厚度，从而使元件的氧化速度变得极为缓慢，趋于稳定。如果继续升温至1627℃以上时，则保护膜受到破坏，氧化速度显著增加，造成元件过早损坏。

The element starts to being oxidized over 800℃ in air; and SiO2 protective film will be generated on the surface of hot zone when temperture get to 1000–1300℃; Cistoba lite will be cry–stallized at 1300℃ the protect film get to a certain thickness when the temperature get to 1500℃ which make the oxidation speed being very slowly to stable. If continue to be heated to over 1627℃,the protect film will be damaged and oxidation speed will be more rapid evidently and make the element damaged earlier.

元件在使用过程中虽然氧化极为缓慢，但长时间运行仍然会导致电阻值增大，这种现象叫做老化。为了减缓老化速度，我们在制造过程中以独特的技术，在发热部的表面涂上了保护层，明显的增强了元件的抗氧化性能，延长了使用寿命。

Though the element will be oxidized very slowly in course of application, it also will make the resistance increased following long time application, this phenomenon calls ageing,In order to lower the ageing speed,we use special technology to spreed a protect film on the surface of hot zone in course of production, which enhance the Antioxid ant property of element evidently and lengthen the service life.

2、碱和碱性金属氧化物对元件的影响 The effects of alkali and alkaline metal oxide to elements.

在1300℃左右，碱和碱性金属氧化物与碳化硅发生反应，生成硅酸盐，称为化学侵蚀，会明显影响元件发热的红热程度。

The alkali & alkaline metal oxide will react with SiC at about 1300℃ and generate slialte,which calls alkalich–emical corrosion, and can influence the glowing of element.

3、熔化金属对元件的影响 The effects to elements from melting metal

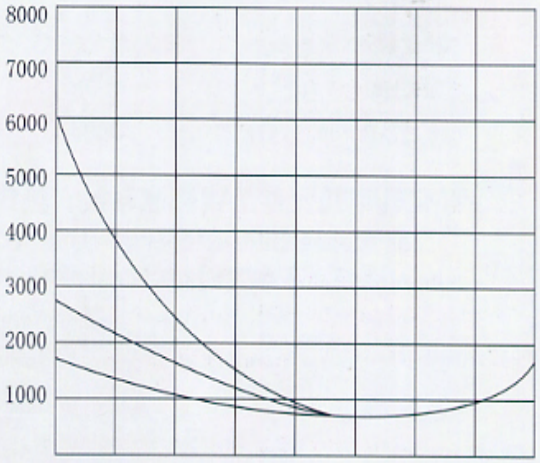
部分金属如钴、镍、铬等在高温熔化状态可以对元件造成侵蚀，影响元件寿命。

Some metals,such as cobalt,nickel,chrome and so on,can corrade the element in high temerature melting state and affect the service life of element.

元件的物理性质 Electric property of elements

碳化硅电热元件具有较大的比电阻，在空气中加热，元件发热部表面温度达到1050℃左右时，电阻率为600～1400Ω/mm²。元件的电阻值随着温度的升高而变化，从室温到800℃为负值、800℃以上为正值特性曲线。

SiC heating elements has rather large specific resistance. When it is heated in air. The surface temperature of the hot zone reaches 1050℃. Its resistance rate is 600～1400Ω/mm². Its resistance value changes as the temperature rises. It shows a natrue curve:negative value from room-temperature to 800℃ and positive value over 800℃。



元件在不同气氛下使用温度和表面负荷的控制

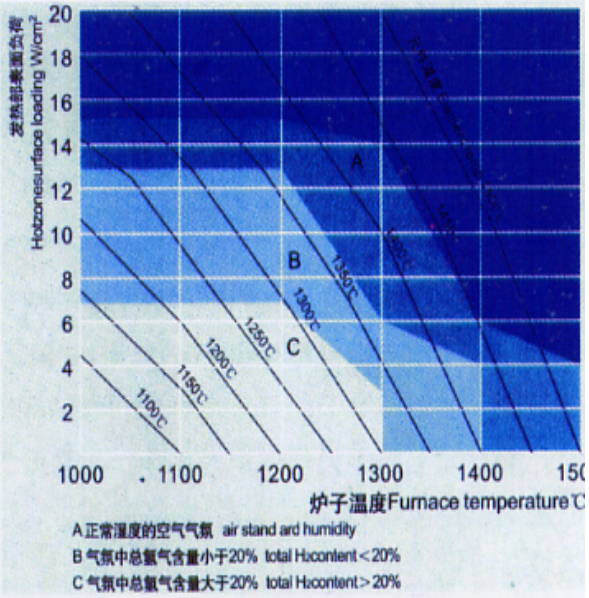
Control of applied temperature and surface load of SiC heating elements under different atmosphere

气氛 Atmosphere	炉温 Furnace Temp(℃)	表面负荷 Surface Load (W/cm^2)	对元件的影响 Acting to the element	解决办法 Solve way
氨 Ammonia	1290	3.8	与SiC作用生成甲烷减少SiO_2保护膜 Acting on SiC to from thus decrease SiO_2 protective film	露点激活 Active at dew point
CO_2	1450	3.1	侵蚀碳化硅Attack SiC	用石英管保护 Protected by quartz tube
18%CO	1500	4.0	无影响No action	
20%CO	1370	3.8	吸附碳粒影响SiO_2保护膜 Adsorbing C grains to act on SiO_2 protective film	
卤素 Halogen	704	3.8	侵蚀碳化硅减少SiO_2保护膜 Attacking SiC and decreasing SiO_2 protective film	用石英管保护 Protected by quartz tube
碳氢化合物 Hydrocarbon	1310	3.1	吸附碳粒而致热污染，分解的碳沉积，易造成电器故障 Absorbing C grains causes hot pollution	送进充分的空气 Fill with enough air
氢 Hydrogen	1290	3.1	与SiC作用反应生成甲烷减少SiO_2保护膜 Acting on SiC to form thus decrease SiO_2 protective film	露点激活 Active at dew point
甲烷 Methane	1370	3.1	吸附碳粒而致热污染 Absorbing C grains causes hot pollution	
N	1370	3.1	与SiC反应生成氮化硅绝缘层 Acting with SiC forms SiN insulating layer	
Na	1310	3.8	侵蚀碳化硅Attact SiC	用石英管保护 Protected by quartz tube
SO_2	1310	3.8	侵蚀碳化硅Attact SiC	用石英管保护 Protected by quartz tube
真空 Vacuum	1204	3.8		
氧 Oxygen	1310	3.8	碳化硅被氧化 SiC is oxided	
水（不同含量） Water(different) contents	1090～1370	3.1–3.6	与SiC作用生成硅的水化物 Acting on SiC forms hydtate of Si	

元件的表面负荷 Surface load of element:

根据炉子的结构、气氛和温度正确地选择元件的表面负荷是达到最佳使用寿命的关键。下图示出了元件辐射在不受阻碍情况下的炉温、元件温度与表面负荷之间的关系。

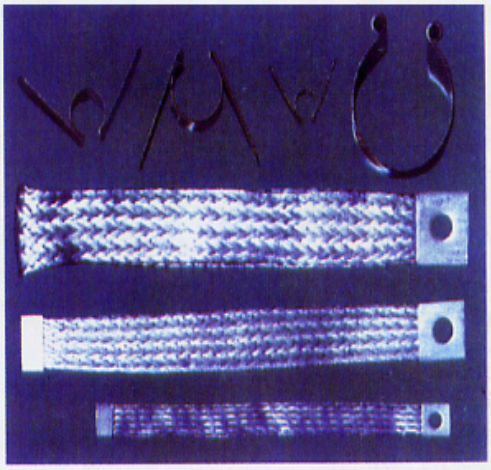
The key factor to the optimum service life of the element is to select the surface load of the element correctly according to the furnace construction, atmosphere and temperature. Below figure shows the relation between furnace temperature, element temperature and element surface load under the condition that the element radiation isn't obstructed.



推荐的元件表面负荷 Recommend surface load:

炉温℃ Furnace Temp.	1100	1200	1300	1350	1400	1450
发热部表面负荷 Surface load of hot zone(W/cm²)	<17	<13	<9	<7	<5	<4

碳化硅电热元件的附件 Accessories of elements



元件安装运行须知 Installation and operation of elements

1、为保持炉温和每支元件的负荷均匀，安装前要对元件进行配阻，每组阻值控制在+/-10%以下。

In order to keep furnace temperature and the load-bearing uniform of each element,before installation,resistance distribution must be carried out. The resistance value deviation of each group should be below 10%.

2、由于碳化硅元件质脆，在安装维修时要小心，以免损坏。

As the element is very brittle, be careful while istalling and maintaining to avoid any damage.

3、炉子在开始通电运行时，要逐步缓慢升压，不可一次加满负荷，否则会因冲击电流过大造成元件损坏。

When starting to operate the furnace,raise voltage slowly and gradually,never give full load at one time, or the heating element will be damaged by over current impulse.

4、使用元件必须配备调压变压器或可控硅调压器及电压、电流表和温度自动控制仪表等。在使用过程中因元件氧化，电阻逐渐增强，为保持炉温正常，应提高使用电压。当电压提高到所用变压器的最高限度仍不能满足要求时，可停炉改变元件的接线方式再继续使用。

To use the elements,you should prepare the adjustable transformer or silicon contralled transformer, voltage meter,current meter and autocontrol temperature meter etc. During the working, the voltage should be increased to maintain the furnace normal temperature because the resistance value will go up gradually caused by the oxidation of element. When the voltage get to the up limit of the transformer and the temerature is still low than the repuirement, the furnace should be stopped,change the way of wire connection and then continue to work.

5、炉子在长期运行过程中，个别元件由于某种原因而损坏需更换时，要根据当时元件阻值增长情况，选补阻值适宜的元件，不可任意取新元件更换。若元件损坏较多或阻值增长过大，无法达到所需炉温时最好全部更换成新元件。换下来的元件重新(用电压表、电流表)测标其电阻值，配阻用在低温区。

In the course of long operation of the furnace, if any individual heating element is damaged owing to certain reasons and should be changed, you should replace it with proper one whose resistance value corresponds to that of the old one, never use a new heating element random. If the heating element is much damaged or its resistance value increases too much and cannot reach the furance temerature,it is better to replace all the heating elements with new ones. Test and mark the resistance value of the old elements having been replaced(with vltmeter and ammeter) and distribute them in low temerature area.

6、新炉或长时间没有使用的炉子，在使用之前必须烘炉，烘炉时尽可能用旧元件或其它热源。

Before the new furnace or the furnace that has not been used for a long time is used,they must be dried, When drying them,it is better to use old elements or other heat source.

7、如果烧制器件或材料时，在加热过程中有水分排出，炉子要留有排气孔，以排除炉内的水分或其它有害废气，以免影响元件的使用寿命。

When firing apparatus or material, if there is water ejection,the furnace should have holes to eject water vapor or other waste gases in order to protect the elements service life.

几种常见接线方法的功率计算

Several power calculation ways for wire connection in common use

接线方法 Connection way	示意符号 Symbol	元件数量 Element Qty (no.)	相电压(V) phase resistance	相电阻(Ω) phase resistance	相电流(A) phase current	总功率 Total power (kw)
单相串联 Single phase Series connection	+	n	Ux=U	Rx=nr	$Ix=\frac{u}{nr}$	$Nx=\frac{u^2}{10^3 nr}$
并相串联 Parallel phase Connection	=	n	Ux=U	$Rx=\frac{r}{n}$	$Ix=\frac{nu}{r}$	$Nx=\frac{nU^2}{10^3 r}$
角形连接 Angle connection	△	n	Ux=U	Rx=r	$Ix=\frac{U}{R}$	$Nx=\frac{3U^2}{10^3 r}$
星形连接 Star connection	Y	n	$Ux=\frac{U}{U}$	Rx=r	$Ix=\frac{Ux}{Rx}$	$Nx=\frac{U^2}{10^3 r}$

注note：U–线电压line voltage　R–元件电阻element resistance