Risesun Hotbar® HD 高密度硅碳棒
High density SiC heating elements

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随着新材料的发展，碳化硅加热元件（硅碳棒）的使用也越来越广泛，在一些领域使用条件也越来越恶劣，比如高镍三元NCM811、NCA的烧结，及玻璃等行业，炉内气氛腐蚀性更强，这就促使耐火材料、窑具和加热元件等不断的提高产品性能以适应市场需求，为此我们最新开发了高密度（HD型）硅碳棒，其具有密度高、气孔率低、抗折强度高、耐腐蚀、使用寿命长等优点。经实验室测试和客户试用，在各种工况条件下寿命比普通产品都提高了50~300%，包括在1530°C的间歇炉内对比、1400°C的连续炉内对比，以及强碱气氛炉内对比等。比如在实验炉1400°C连续加热4200小时后，洁净的空气气氛，表面负荷约4W/CM^{2}条件下，普通棒电阻增长了约62%，平均每1000小时增长约14.7%；而高密度棒电阻只增长了约32%，平均每1000小时增长约7.7%。

Along with the developing of new materials, SiC heating elements is more and more widely used, meanwhile, the working conditions of SiC heating elements are getting worse and worse in some fields, such as sintering of NCM811 & NCA, glasses industries and so on, the corrosivity of atmosphere in furnace is very strong, higher corrosions from furnace atmosphere, which presses manufacturers of refractories, kiln furniture, heating elements to improve performance of the products continuously in order to match demands of the market. Therefore, we developed high density (HD type) SiC heating elements successfully, which has advantages of higher density, lower porosity, higher rupture strength, anti-corrosion and longer service life. By lab test and clients' trial run, the service life of our high density SiC heating elements improved more than 50%~300% under various working conditions, the comparisons including in 1530°C intermittent furnace, 1400°C continuous furnace, furnace with strong alkali atmosphere, etc. For example, after heating in lab furnace with 1400C° and clean air continuously 4200 hours and surface loading 4W/ CM^2, resistance of common elements increased about 62%, average increasing 14.7% per 1000 hours; but for high density elements, which only increased about 32%, average increasing 7.7% per 1000 hours.

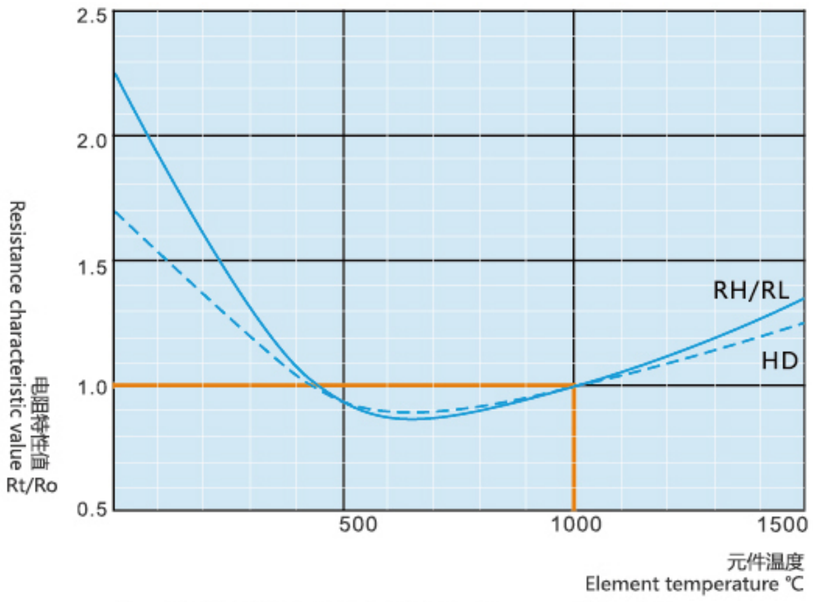
下面是普通硅碳棒（RH & RL型）和高密度硅碳棒（HD型）的物理性能对比表：

Physical performance contrast table of common elements (RH & RL type) and high density elements (HD type) is the following:

项目Item	单位unit	型号 Type	
		RH & RL	HD
密度Density	g/cm^3	2.5	2.65
气孔率Porosity	%	23	18
抗折强度Rupture strength	MPa (25°C)	50	60

另外，高密度硅碳棒的有着更平缓的电阻-温度变化曲线，假设在1000°C时硅碳棒的电阻为1.0Ω，不同温度时普通棒和高密度棒的温度-电阻变化如右图和下表所示：

Furthermore, high density elements has more smooth resistance-temperature curve, assuming 1.0Ω resistance value of elements at 1000°C, the variation of temp.-resistance value of common and HD type elements as shown in the right figure and below table:



Ro: 元件在1000℃时的电阻值 Resistance at 1000℃
Rt: 元件在不同温度时的电阻值 Resistance at each temperature

温度 Temperature	25°C	200°C	400°C	600°C	700°C	800°C	900°C
普通型 RH & RL	1.5~3.5Ω	2.20Ω	1.50Ω	0.80Ω	0.84Ω	0.89Ω	0.93Ω
高密度 HD	1.3~2.0Ω	1.80Ω	1.30Ω	0.81Ω	0.85Ω	0.90Ω	0.94Ω
温度 Temperature	1000°C	1100°C	1200°C	1300°C	1400°C	1500°C	
普通型 RH & RL	1.00Ω	1.06Ω	1.14Ω	1.23Ω	1.32Ω	1.40Ω	
高密度 HD	1.00Ω	1.06Ω	1.12Ω	1.17Ω	1.19Ω	1.22Ω	

从上表可以看出，一是高密度棒在低温时的电阻一致性更好，从而可以在较低炉温时获得更好的炉温一致性；二是高密度棒在高温时的电阻变化更小，尤其是在1200°C以上更为明显，这就提供了更长的高温寿命。

Seeing from above table, firstly, the resistance consistency of HD type elements is better under lower temperature, as a result, furnace will get better temperature consistency under lower temperature; secondly, under high temperature, the resistance variation of HD type elements is smaller, especially more apparent while temperature higher than 1200C°, which will provide with longer service life of elements under high temperature.

另外，由于高密度棒原料的特性和密度的提高，高密度棒可以生产出相对于普通棒低的多的电阻值，比如30*1000发热区的硅碳棒，普通棒最小可以做到1.2欧姆左右，而高密度棒可以做到0.9欧姆甚至更低，这就为窑炉电气系统的设计提供了更多的选择，比如更多数量硅碳棒串联连接的可能。

Furthermore, due to the characters of the raw materials of HD type elements and also improvement of density, HD type elements can be produced with much lower resistance value compared to the common ones. For example, dia 30mm elements with 1000mm hot zone, the min. resistance value of common elements can be produced is about 1.2 ohms, but for HD type elements, 0.9 ohm is available even more lower, which provides with more options for design of electrical system of furnace, such as more elements in series connection.

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