Heraeus

HRC® – Heraeus Reflective Coating

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What is HRC®
Heraeus Reflective Coating (HRC®) is an opaque coating made of pure silica (SiO_2). It can be applied to quartz products from simple geometries to customized complex systems. It has excellent reflection properties that can be utilized to optimize the heat management in high purity quartz glass process equipment used in the semiconductor or photovoltaic industry.

Using HRC® in your application
In complex high temperature processes, heat distribution is determined by three heat transfer mechanisms
- Convection
- Conduction
- Radiation

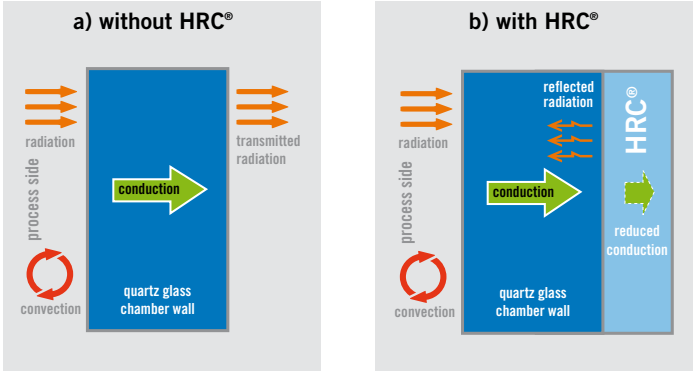

Figure 1: Illustration of the three heat transfer mechanisms.

In many cases convection and conduction are resulting from specific system designs, but also from material and process parameters. The influence of heat radiation is often not intentionally controlled. HRC® can influence the radiation configuration of the system.

Your benefit using HRC®
Based on several patents, HRC® allows to optimize the radiation performance of complex quartz products in a highly flexible way. Depending on your specific application, HRC® can be applied on any quartz surface of your process.

As an example, HRC® can save energy wherever heat sources or IR-radiating components are located inside of quartz chambers by by reflecting heat radiation back into the process (see Figure 1).

In addition, HRC® can be used to manage temperature profiles by tailoring the reflecting surfaces of your system. This can be beneficial to your yield.

Thermal and chemical properties
HRC® is made from pure silica. Therefore, many attractive material properties like the high temperature properties of quartz glass are applicable to HRC® such as
- high temperature stability
- thermal shock resistance
- purity
- chemical inertness.

Moreover, HRC® shows a decrease in thermal conductivity by 50% compared to electrically fused quartz.

Application temperatures
- Short-term: < 1300 °C
- Long-term: < 1100 °C

Thermal conductivity*
- λ = 0.72 W/(m·K) ± 10% (20 – 170)°C

Specific heat
- c_p = (0.86 – 1.2) J/(g·K) ± 5% (50 – 500)°C

** compare to HSQ 300: λ = 1.38 W/(m·K) 20°C*

Composition
HRC® is produced without any use of additives. The trace element content is equivalent to standard semiconductor quartz grades. Synthetic raw materials could also be used depending on customer requirements.

Typical trace element content

[ppm]	Al	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	Ti	Zr
HRC®	8	0.2	< 0.1	< 0.05	< 0.7	0.1	0.05	< 0.05	< 0.05	0.1	0.5	0.3
HSQ 300	15	0.5	< 0.05	< 0.05	0.1	0.4	0.6	0.05	< 0.05	0.3	1.1	0.7

Microstructure

The reflection properties of HRC® originate from the microporosity of the material, as seen in Figure 2 from SEM micrographs. After a specific sintering procedure, the material incorporates micropores which are responsible for its white-opaque appearance. In this, HRC® is very similar to OM 100, the opaque bulk material from Heraeus Conamic.

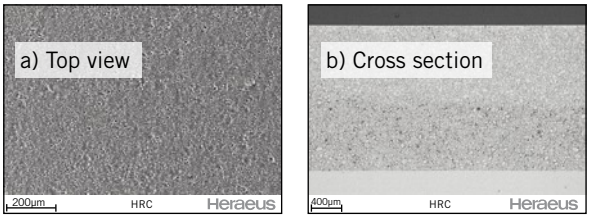

Figure 2 a) SEM micrograph of a typical HRC surface.
Figure 2 b) SEM micrograph of a typical HRC cross section.

Reflection behavior

HRC® is an excellent reflector material. Figure 3 shows typical reflection data. To specify the effect of HRC® in the application, it is necessary to know the spectral density of the heat radiation. The more overlap between heat radiation spectrum and reflection spectrum of HRC® the more influence on the application will be achieved.

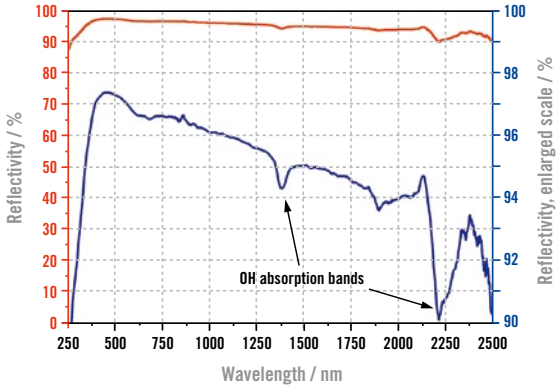

Figure 3: Reflection behavior of a typical HRC® surface.

Due to its specific microporosity, the directional reflection properties of HRC® behave like an ideal Lambertian reflector, i.e. incoming radiation is reflected isotropically in all directions as shown in Figure 4.

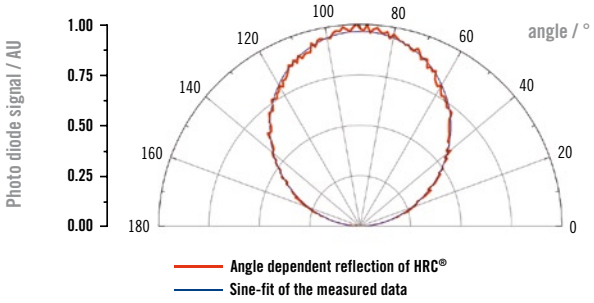

Figure 4: Typical directionality of the radiation reflected by HRC®. Reflected radiation is distributed isotropically, following the characteristics of a Lambertian reflector.

Other properties

Density
- ρ ~ 1.75 g/cm³

Typical thickness
- 0.8 mm – 3.0 mm

Flexibility, can be applied to almost any geometry
Removable with HF for refurbishing purposes

Our service

Heraeus Conamic develops, produces and supplies tailor-made quartz solutions. Please feel free to contact us to discuss your specific quartz requirements.

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