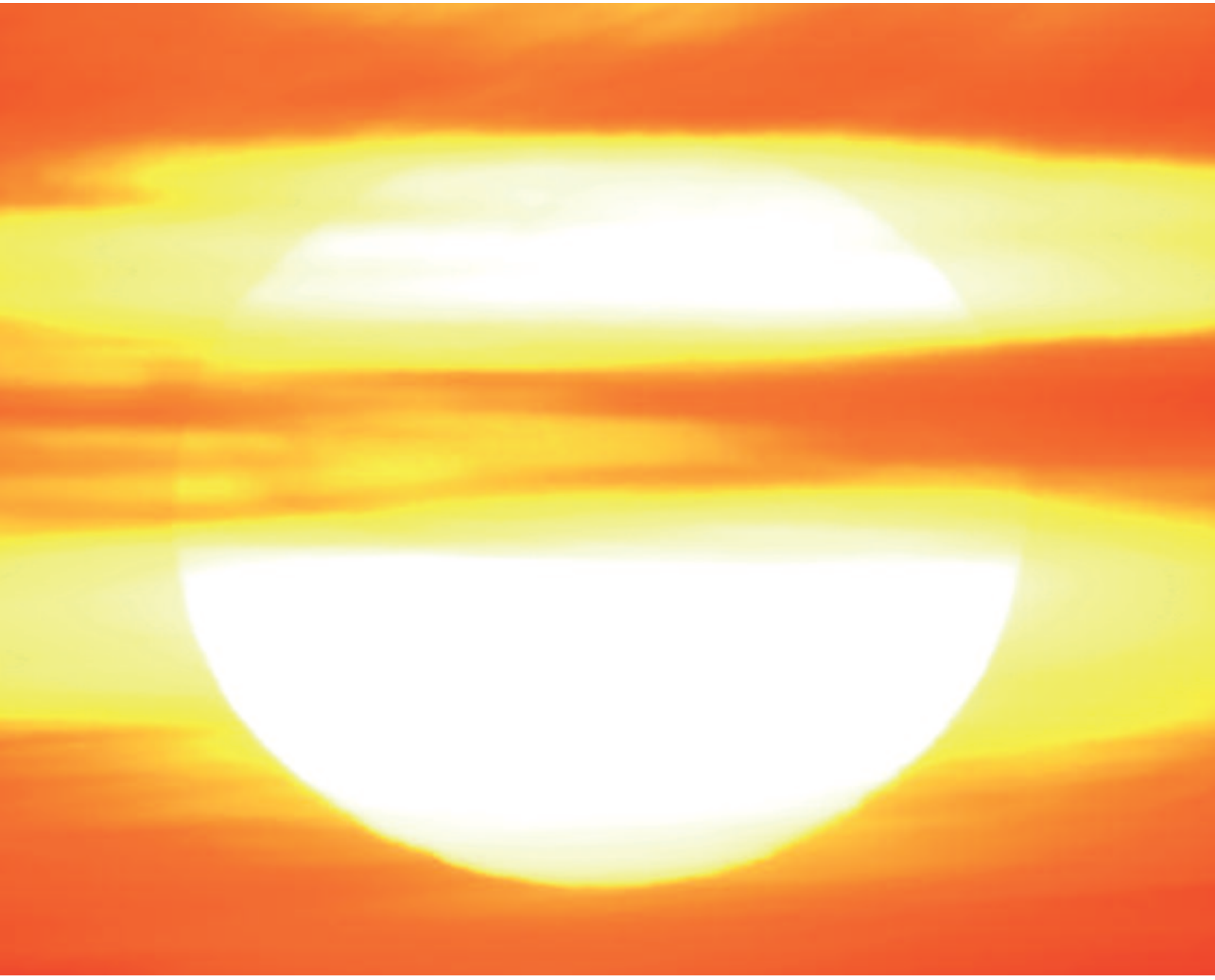
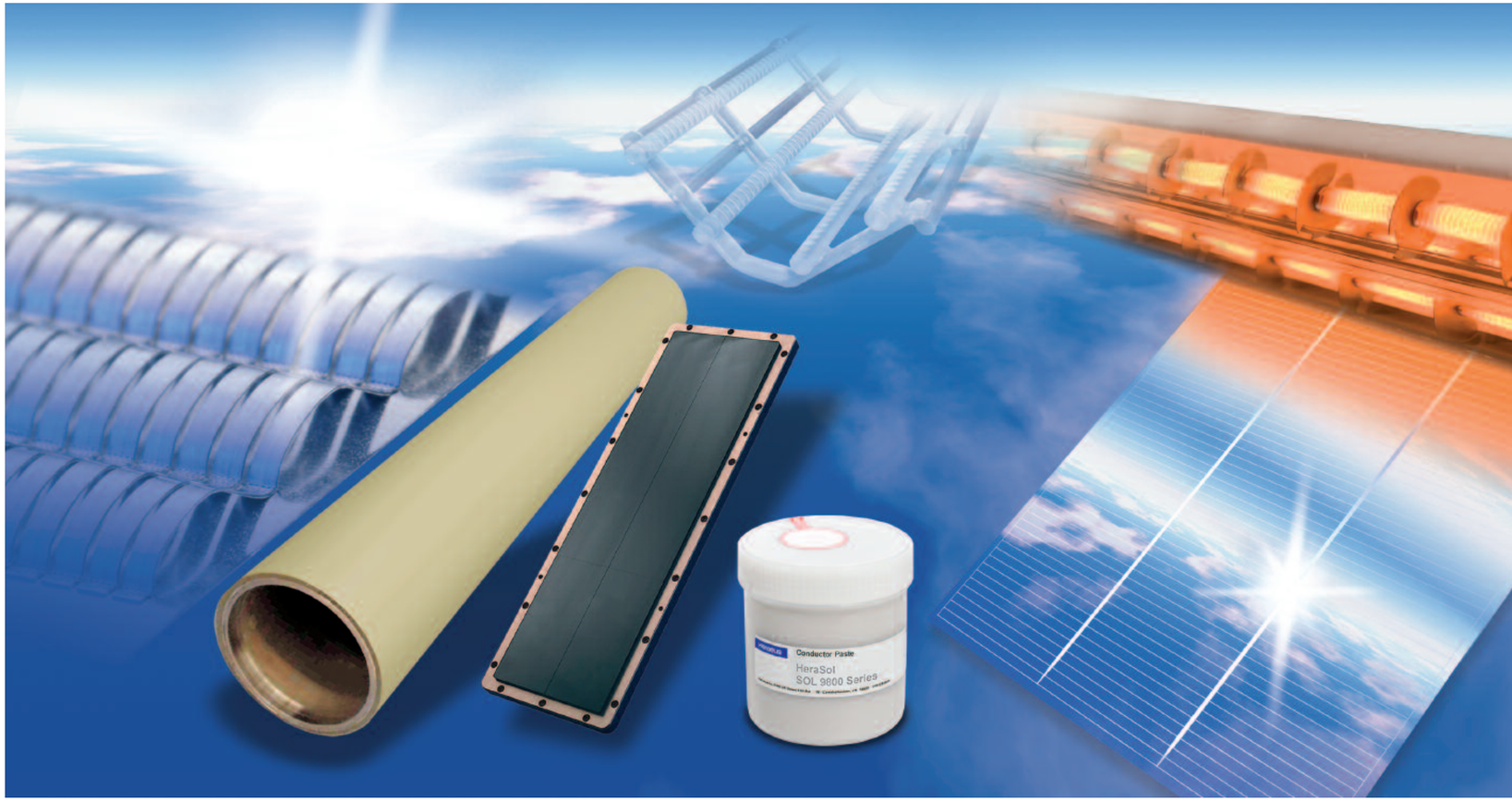
Heraeus



Products for the Photovoltaic Industry

Products from Heraeus for the Photovoltaic Industry

Precious metals such as platinum and gold, dental and medical products, sensors, quartz glass, and specialty lighting sources: with innovative developments and sophisticated materials technology, Heraeus has been setting standards in these sectors since 1851. With revenues exceeding 12 billion Euros and more than 11,000 employees in over 100 companies worldwide, the precious metals and technology group, headquartered in Hanau, is a globally recognized precious metals and materials specialist.



Photovoltaic

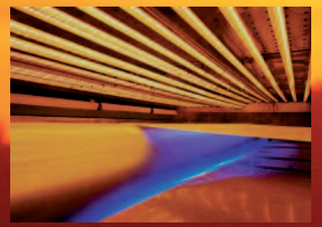
The principle of the photoelectric effect was detected as early as 1839 by the French physicist Alexandre Edmond Becquerel. In 1905 Albert Einstein successfully explained the photoelectric effect, for which he was awarded the 1921 Nobel Prize in Physics.

Heraeus focuses specifically on opportunities to produce electric current from solar power. The operating companies W. C. Heraeus GmbH, Heraeus Quarzglas GmbH & Co. KG and Heraeus Noblelight GmbH are knowledgeable contacts for innovative solutions both for plant and machinery producers and for cell manufacturers. Due to the worldwide presence of their development, sales and production locations they are close to customers and the market. You will find products for all three photovoltaic generations at Heraeus.

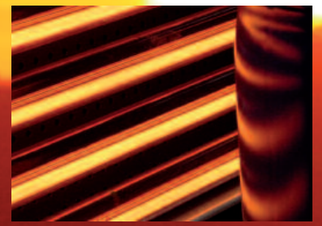
Content

Infrared Heaters	4 – 5
Quartz Materials	6 – 7
Sputtering Targets	8
Conductor Pastes	9
Flexible Substrates	10
Clad Strips	11
Wires and Ribbons	12
Precious Metal Compounds	13
Contacts	14 – 15

IR heater matching exactly to product and process



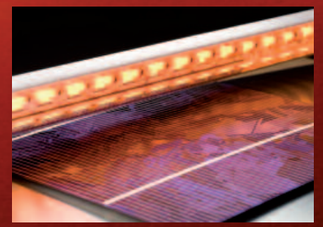
Processing of foils with IR systems



Carbon emitter to dry coatings

Processing of silicon with a QRC® heater

IR heater with a QRC® reflector



Production of solar cells with a QRC® heater

For decades Heraeus Noblelight has been a competent manufacturer of infrared heaters for industrial heating processes.

Drying, sintering and string soldering – the manufacturing of solar cells requires heat in many of the individual production steps. Infrared radiation is a high energy, contact-free method of heat transfer which saves time and production space.

The benefits of infrared heat can also be achieved under extreme process conditions.

Thanks to the newly developed quartz reflector, the heating of carrier materials before or during coating processes can be carried out more efficiently in vacuum or at high ambient temperatures.

Solar cells aim to make optimum use of solar energy. An anti-reflective coating provides a significantly better absorption performance for solar cells. This coating is deposited in vacuum and at high temperatures.

It has been established that such high temperature processes can be carried out in a significantly more stable fashion using infrared emitters featuring the new QRC® (quartz reflective coating) reflectors, so that process parameters such as the temperature or heating time can be better maintained. This increases the energy efficiency of the system.

Heraeus Noblelight works closely with their customers and offers infrared heaters which can be designed in terms of shape, size and spectrum to suit the relevant process.

The heating steps of some innovative processes are thus made possible, and complex heating processes can be reproduced to permit automation.

Quartz glass crucibles

Semifinished products made from quartz glass

Detail of a process chamber

Substrate carrier made of quartz glass

Due to its unique properties, quartz glass is an irreplaceable material for many processes within the semiconductor and photovoltaic industries.

These properties include: excellent temperature resistance as well as high thermal shock resistance, a low thermal expansion coefficient, extraordinary chemical purity, high corrosion resistance and exceptional transparency between 160 nm and 4000 nm wavelength.

Quartz glass is used particularly in high temperature processes such as the production of silicon single crystals from the melt and other high-temperature or diffusion processes. Crucibles, reaction chambers and carriers are typical products made of quartz glass.

Quartz glass is among the preferred materials used in the production of first-generation solar cells. It is used for industrial silicon production as well as for the further processing of silicon wafers into solar cells.

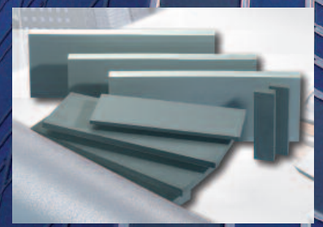
Quartz glass components are also used for the manufacture of second-generation solar panels, i.e. thin film technologies.

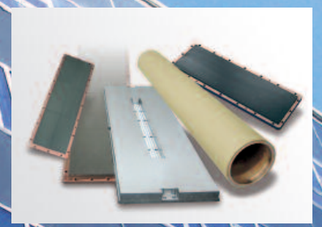
As the world's largest integrated quartz producer, Heraeus Quarzglas has accelerated innovations in quartz glass technologies for more than 100 years. The technological variety is demonstrated by over 5000 products in the standard product portfolio.

Each product is specialized to its relevant field of application. For this purpose, all common manufacturing and processing methods are employed.

Special, proprietary technologies complete the spectrum of capabilities. Heraeus Quarzglas develops, produces and supplies tailor-made solutions – from base materials up to complex system components – from one source.

Sputtering Targets from W. C. Heraeus





Sputtering targets for photovoltaic applications

The Thin Film Materials Division is one of the world's leading producers and developers of sputtering targets for use in the field of thin film technology.

The Division is able to supply targets for all of the key layer systems used in photovoltaic applications. In close co-operation with photovoltaic customers and plant manufacturers the Division has already succeeded in establishing a large number of innovative planar and rotatable targets on the market.

Standards have risen considerably, and most particularly in the thin film photovoltaic industry, from a technical as well as an economical point of view.

The Thin Film Materials Division offers direct solutions to suit the customer. Their ability to convince is based on many years experience of innovation and development, in-depth vertical range production know-how and competent advice on applicational technology.

Sputtering targets for photovoltaic applications based on cell types

CIGS	a-Si	CdTe	Wafer based
ZAO®, In, CuGa, ZnO, Mo, CIG, CuIn, ZnAl	ZAO®, ZnO, Al, Mo, NiV, Ag	ITO, Sn, Mo, NiV	Si, SISPA®, Al, Ag

Conductor Pastes from W. C. Heraeus

HeraSol™ pastes

The Thick Film Materials Division of W. C. Heraeus is market leader in electronic materials such as thick film pastes and materials for passive components and hybrid circuits, as well as advanced materials such as LTCC materials and photo-etchable pastes.

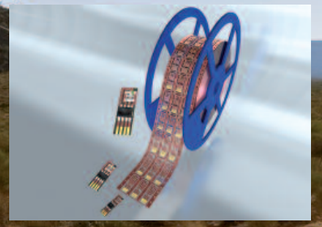
Due to the development of conductive pastes, this expertise can be used in the photovoltaic industry.

HeraSol™ is the brand name for products that are used to apply electrical contacts to solar cells of the first photovoltaic generation (wafer based cells).

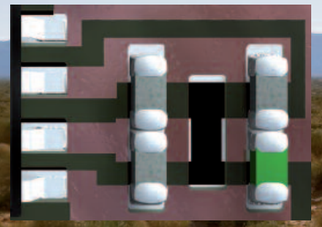
The conductive pastes are based on silver. The HeraSol™ series is cadmium-free and the printing properties are excellent. After firing, the series stands out due to its high efficiency and fill factor along with excellent line resolution. Lead-free formulations are also available.

Front side silver pastes		Back side silver pastes	
SOL 9XX	SOL 93X	SOL 2XX	SOL 23X
Peak temperature 750 to 850°C cadmium-free	Peak temperature 725 to 825°C lead- and cadmium-free	Peak temperature 750 to 850°C cadmium-free	Peak temperature 725 to 825°C lead- and cadmium-free

Flexible Substrates from W. C. Heraeus



Sensors



Application of sensors on flexible substrates

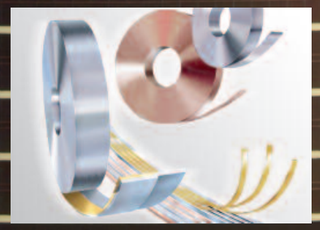
The Business Unit Precision Technology has extensive experience and expertise in the field of materials technology. The production of sophisticated flexible substrates in mass production is one of the key competences of the Business Unit.

This technology enables the cost-effective production of connection methods and substrates for the solar and photovoltaic industry.

To meet customer requirements the following technologies are available:

- Stamping of flexible substrates
- Laminating of PEN, PET, polyimide, epoxy and many others
- Plating of gold, nickel, silver, palladium, tin and others
- Etch technologies
- Flexible Cu-alloy substrates from 60 µm to 100 µm
- Surface refinement to generate bonding areas, contact and soldering areas.
- Multilayer structured laminates to meet the requirements of the electronics industry such as bonding, temperature stress and wettability.

Clad Strips from W. C. Heraeus



Multiple roll clad strips

Coated semi finished ribbons

The Engineered Materials Division is a producer and fabricator of high purity metallic materials for technical applications.

The technical expertise of the Engineered Materials Division is the processing of precious metals and refractory metals to components, semifinished products or film systems as well as their subsequent processing. Applications are the electronic packaging of integrated circuits.

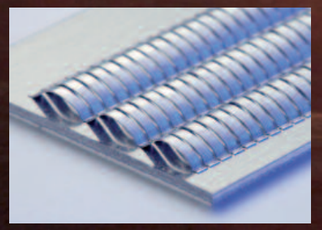
The Business Unit Semifinished Products manufactures tailor-made clad strips and wires.

The following technologies are available:

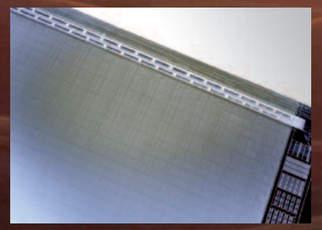
- Milling
- Electroplating
- Sputtering

Using these technologies tailor-made solutions for conductors for photovoltaic cells are offered.

Wires and Ribbons from W. C. Heraeus



Aluminum ribbons



CSG Solar module with Al-ribbon bonded from Orthodyne

Al-ribbon for power applications

W. C. Heraeus' Bonding Wires Business Unit is considered to be one of the best addresses in the field of microcontact technologies. The Division manufactures fine and ultra-fine wires for bonding technologies. The current range of products includes pure gold and copper bonding wires as well as aluminum wires.

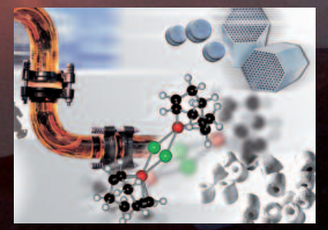
Due to their corrosion resistance and other positive aspects, aluminum ribbons are an alternative for contacting thin film solar cells.

These materials distinguish themselves for use in the power electronics industry by their stable high degree of accuracy and high conductivity. By using fully automated bonding technologies the following advances for the solar industry are achieved:

- High life cycles of the modules due to direct metal based connection with low corrosion
- Cost reduction of the modules due to high automatization
- Low material costs in comparison to traditional soldering

Precious Metal Compounds from W. C. Heraeus

Organo-rhodium compound



Ruthenium complex for solar dyes

W. C. Heraeus' Business Unit Chemical Products manufactures organometallic compounds and their precursors on a commercial scale.

Flexible production technologies enable the Business Unit to synthesize an extensive number of precious metal compounds as well as tailor-made molecules and complexes.

Moreover, Chemical Products also develops and manufactures compounds in close co-operation with its customers. Confidentiality agreements are a matter of course.

Besides product expertise, Chemical Products offers concepts for procuring precious metals in close collaboration with Heraeus' own metal trading company.

Full cycle operations for the recovery of precious metals from various materials are an integral part of W. C. Heraeus' daily business.

Chemical Products already supplies ruthenium complexes for dye-sensitized cells ("Solar Dyes") of the third-generation solar technology.

Contacts

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Europe

Asia

Infrared Heaters


Picture: Christian Weigel (and Title)

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Quartz Glass


Picture: Christina Milkau

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Sputtering Targets


Picture: Silke Jansen

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Conductor Pastes


Picture: Bernd Korzendörfer

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Flexible Substrates


Picture: Dr. Jürgen Müller-Schäfer

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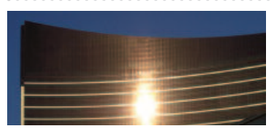
Clad Strips


Picture: Jochen Ruppel

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Wires and Ribbons


Picture: Rainer Jonzyk

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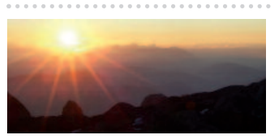
Precious Metals


Picture: Christina Milkau

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