

Heraeus



Metallization Materials for Silicon Solar Cells
HeraSol

Metallization Materials for Silicon Solar Cells

HeraSol

Heraeus Group

Heraeus – a globally active precious metal and technology group – is a market and technology leader in the areas of precious metals, sensors, dental and medical products, quartz glass and specialty lighting sources.

The Thick Film Business Unit of W. C. Heraeus, established over 40 years ago, is a market leader in electronic materials like thick film pastes and materials for passive components, as well as advanced materials like LTCC products and photo-etchable pastes. Heraeus has extensive expertise in the development, application, and processing of thick film materials. A diverse product offering has evolved over years of experience to include metallization materials for solar cells.

HeraSol compositions for Photovoltaic Industry

The Heraeus SOL compositions are a series of screen printable front and back side silver conductors and already qualified in the market by leading solar cell manufacturers. The pastes are all cadmium-free and tailored solutions for either SiNx or TiOx anti-reflective coatings. Lead-free formulations are also available. The fired pastes exhibit low contact resistance, high efficiency and fill factor along with excellent peel adhesion strength and a good failure mode. These properties are achieved over a generous process window. All SOL 9XX and SOL 2XX pastes are co-fireable with commercial back side Ag/Al pastes. For back side solder applications, Heraeus is introducing the new lead-free silver paste SOL 230 with significantly lower material consumption, and excellent initial and soldered aged adhesion, employing leaded and lead-free solders.

Additional formulations are available which allows the use of our materials as inks or suspensions which can be applied by ink jetting, dipping or decals used in manufacturing silicon based solar cells.

Key Benefits of SOL series

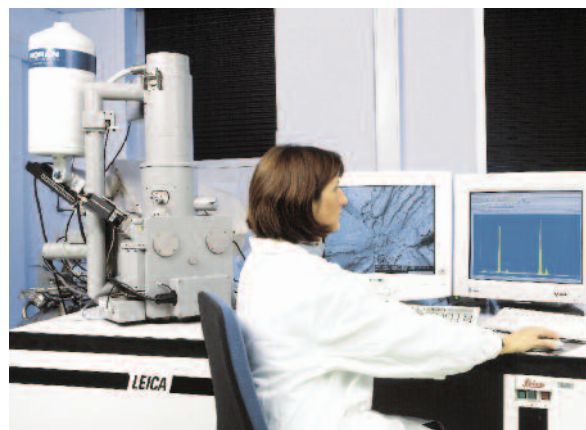
- High efficiency and fill factor
- Low contact resistance
- Excellent line resolution
- High print speed and excellent mechanical properties
- Co-fireable with backside Al and Ag/Al paste
- Cadmium-free/Pb-free Ag paste formulation
- Tailored formulation for different wafer types
- Highly integrated in-house manufacturing

Competence Team and Application Centers

Based on an innovative R&D team, global manufacturing expertise and regional Key Account Management we are able to provide a strong customer relationship and individual solutions. It has been our experience that the selection of the correct front-side conductor composition can be complex, as system performance is sensitive to the cell structure, the Anti-Reflective Coating (ARC), and the firing profile. For this reason we suggest that a manufacturer new to our product test variations of these formulations, in order to capture the subtle advantages that one of them may offer for a particular cell type. Additionally we will also be carrying out time and cost saving process optimization by means of customer parameters and materials in our own Application Centers which are located in Hanau (Germany), West Conshohocken (USA) and Shanghai (China). An added advantage to the customer is the "outsourced" process optimization, no cost-intensive test and idle times in the line are incurred. Thus productions gain additional valuable production times. Obviously, training and process optimization services will also be conducted "on site" if requested.

In our own Technology Centers which are an integral part of the comprehensive quality assurance system of Heraeus, we realize for decades materials investigations for quality assurance, failure analysis and R&D.

We are also investigating in new, gentler contacting methods, which can be applied industrially and yet still offer the potential for higher cell efficiency and encourage our customers to work with us to find the best fit for them. Long-term cooperation with customers and research institutes paves the way for new products. Whenever you seek materials expertise, Heraeus stands as your guide and partner.

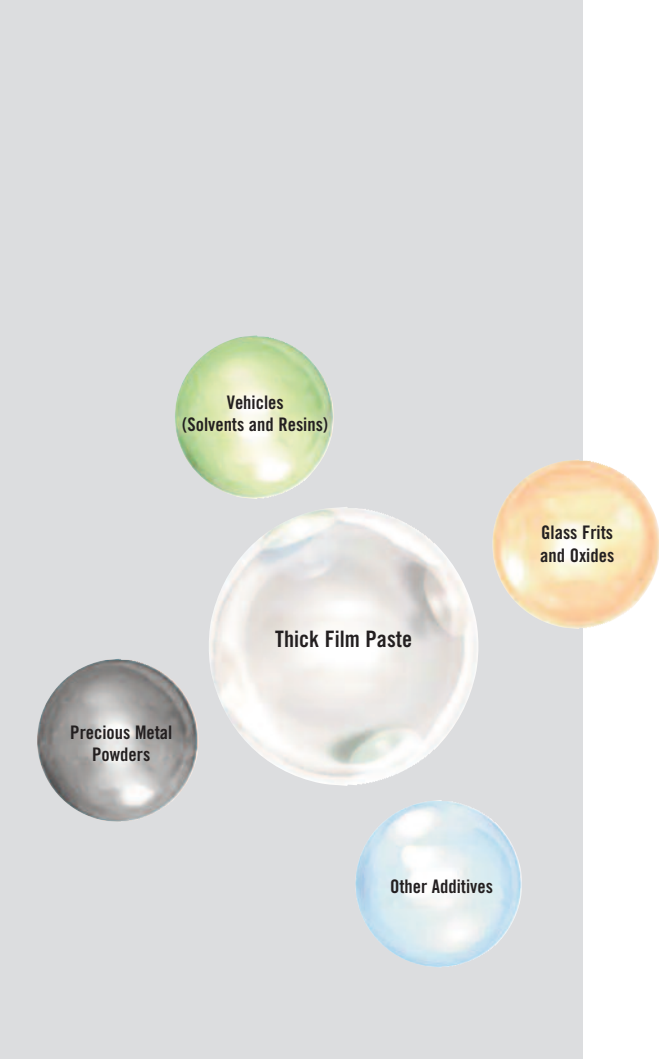


Heraeus Technology Center – Materials Investigations

Tailored solutions for si-Solar Cells: SOL series

Our core competence is the highly integrated in-house manufacturing of inorganic and organic compounds and additives to realize leading metallization systems. Thus we are able to offer metallization materials that provide improved efficiency levels and lower cost per watt to PV modules. The materials properties are tailored to the requirements of the front and back sides of silicon wafers. Careful optimization of the materials and process is continuously done to secure state-of-the-art products. Our SOL silver conductors are fireable in a variety of IR furnaces. The firing profile for best performance is determined by the cell configuration and process conditions. Optimum peak firing temperatures were detected between 750 °C and 850 °C.

Additional formulations e.g. for special wafer design are available, in order to capture the subtle advantages that one of them may offer for a particular cell type.



Heraeus SOL series for silicon Solar Cells

	SOL 950	SOL 9XX ³⁾	SOL 230 Pb	SOL 2XX ³⁾	SOL XXX ³⁾
	N-type front side silver for general application	N-type front side silver for HSR emitters	Lead-free pure silver tabbing conductor	Pure silver for back contact configurations	Metallization materials for other solar applications
RoHS compliance	Cd-free	Cd-free	Cd- / Pb-free	Cd-free	<ul style="list-style-type: none"> ■ Low temperature Ag pastes and inks ■ Polymeric thick-film conductor ■ Ink Jet solutions ■ Nanoparticles ■ Powders and suspensions
ARC layer	SiNx / TiO ₂	SiNx	back side	back side	
Resistivity [mOhm/sq]	< 4	< 4	< 4	< 4	
Solids content [wt.%]	82 - 84	84 - 87	70 - 73	82 - 86	
Print resolution [µm lines]	100 - 150	90 - 120	100 - 150	100 - 150	
Emitter sheet resistance	40 - 65 Ohm/sq	65 - 85 Ohm/sq	all	all	
Viscosity [Pa*s] ¹⁾	180 - 220	180 - 260	80 - 140	180 - 260	
Fired film thickness [µm]	10.0 - 16.0	14.0 - 25.0	7.0 - 10.0	10.0 - 18.0	
Adhesion and solderability	very good	very good	excellent	very good	
Peak temperature [°C] ²⁾	750 - 800	750 - 800	725 - 825	750 - 800	
Curing/drying temperature [°C]	250 - 300	250 - 300	250 - 300	250 - 300	
Mesh no. (st. st. screen)	280 - 325	280 - 325	200 - 230	280 - 325	
Key benefits	<ul style="list-style-type: none"> ■ N-type front side Ag conductor for single and multicrystalline silicon solar cell wafers. ■ Compatible with commercial rear silver pastes as well as lead-free and low bow aluminum pastes. 	<ul style="list-style-type: none"> ■ N-type front side Ag conductor for single and multicrystalline silicon solar cell wafers. ■ For high buildup and fine line printing ■ Low resistance contact, suitable for shallow emitters ■ Compatible with commercial rear silver pastes as well as lead-free and low bow aluminum pastes. 	<ul style="list-style-type: none"> ■ Specially designed as a back contact for silicon solar cells which utilize an aluminum BSF ■ Excellent adhesion on textured or untextured wafers ■ Allows the use of lead bearing or lead-free solder ribbons. ■ Excellent coverage (95 cm²/g with fired film thickness of 10 µm) 	<ul style="list-style-type: none"> ■ Pure Ag conductor specially designed for back contact configurations ■ RoHS compliant; cadmium-free ■ Excellent shunt resistance and through hole properties 	<ul style="list-style-type: none"> ■ Heraeus offers a broad and growing portfolio of materials for PV application. Let us come together and see what we can do for you!

1) Brookfield HBT, SC4-14 US & SP @ 10 rpm @ 25 °C

2) Actual wafer temperature

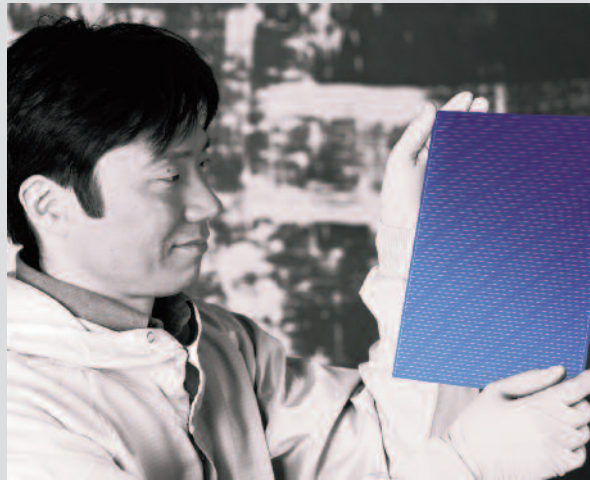
3) Suitable paste to be determined on your processing conditions

Innovation@Heraeus

With 25 development centers and more than 4,700 patents and patent applications, Heraeus demonstrates its innovative strength worldwide. As a science-based company, founded in 1851, a number of factors contribute to the successful development of new products and innovations. For example, research and development at Heraeus is not concentrated in a central location. International and interdisciplinary cooperative ventures and partnerships with universities and research institutes help Heraeus to discover new ideas and meet country-specific customer requirements.

Efficient processes with Heraeus materials

Heraeus belongs to the leading addresses in the industrial precious and special metals business worldwide. The consortium of businesses in Europe, North America and Asia maintains production capacities for all stages of precious metal production and processing. Meanwhile Heraeus has also adopted a wide expertise in solar cell applications and developed leading products for this promising market. In addition to our HeraSol front side silver for crystalline solar cells we supply a complete package of sputtering targets for various types of solar cells and modules (crystalline, CIGS, CdTe, a-Si) as well as aluminum ribbons, connector ribbons, solder pastes, conductive adhesives and quartz products.



Localized Sales and Technical Support

Heraeus has over 40 years of experience in the development, manufacture, sale, and support of specialized thick film compositions for a wide variety of electronic materials and is present worldwide with 76 production facilities and 25 development centers. Our global network of sales and service offices are located close to the customer site for quicker turnaround and lower processing costs. The Thick Film Business Unit of W. C. Heraeus has research and manufacturing sites in the U.S.A., Germany and China.

Modern production facilities and state-of-the-art products as well as quality assurance are certified to DIN ISO 9001 and ISO/TS 16949 which are fundamental components of the corporate philosophy. In close collaboration with our suppliers, top performing materials with consistent quality are selected to meet all customer specifications. For more information on HeraSol metallization systems, please contact your local representative.

Europe

W. C. Heraeus GmbH

Thick Film Materials Division
Heraeusstr. 12-14
63450 Hanau, Germany
Phone: +49 (0) 6181.35-5466
th-info@heraeus.com
www.heraeus-th.com

Americas

Heraeus Incorporated

Thick Film Materials Division
West Conshohocken
PA 19428, USA
Phone: +1 (610) 825.6050
techservice.hcd@heraeus.com
www.thickfilm.net/solar

Asia

Heraeus Materials Technology Shanghai Ltd.

No. 1 Guang Zhong Road
Zhuanquiao Town, Minhang District
201108 Shanghai, P. R. China
Phone: +86 (21) 6442.6838
th.hmmts@heraeus.com
www.heraeus-th.com