Fascination Light –
Smart Materials for LED Lighting
Heraeus, renowned as an expert for high-end materials, offers a broad product portfolio for the LED industry. Through our material competence and extensive market knowledge we are a reliable and strategic partner to this industry.

The Hanau, Germany based precious metal and technology group Heraeus is a globally operating and family-run enterprise with a history of more than 160 years. Our areas of competence include precious metals, materials and technologies, sensors, biomaterials and medical devices, quartz glass and specialty light sources.

HIGHLIGHTS OF OUR MATERIALS PORTFOLIO FOR LED MANUFACTURING

SUBSTRATE
- Heraeus CoolStrates™ customized boards and Heraeus Celcion™ thick film materials – for reduced processing steps, lower materials consumption and more flexibility in manufacturing
- Stamped Circuit Boards – a highly innovative and sophisticated substrate solution for LED packages

INTERCONNECT
- Conductive adhesives, solders, and sintering materials – for superior thermal and electrical conductivity
- Highly reliable gold bonding wires – for high strength and excellent loop stability
- Sputtering targets and evaporation materials for PVD processes – enabling the production of ultrathin and homogenous layers

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Substrates

Heraeus CoolStrates™ and Heraeus Celcion™

Heraeus offers the thick film based alternative to traditional MCPCBs:

With Celcion™ Heraeus delivers compatible thick film pastes to build circuits directly onto aluminum substrates. Heraeus CoolStrates™ are customized boards, combined modules of Celcion™ on Al substrates.

These materials are primarily used in the field of high power LED Substrates, Concentrated Photovoltaics, Power Electronics and Heaters.

Celcion™

- Compatible with 3000, 4000, 5000 and 6000 series aluminum alloys
- High design flexibility
- Excellent adhesion to Al substrates
- Pb-free and RoHS compliant

CoolStrates™

- Superior thermal management
- Long lifetime and high reliability
- Color stability of lighting
- Ul recognized

Celcion™ consists of insulating dielectric paste, conductor paste and covercoat. Its unique glass system minimizes bowing on aluminum while providing high dielectric breakdown strength and good thermal conductivity. The versatility allows quick and inexpensive design changes and lower material consumption compared to the traditional MCPCB system.

**Thick Film Technology Benefits**

- Reduced processing steps
- Less material consumption (additive processing)
- Simplified bill of materials (single-part dielectric system)
- Inert glass/metal system - no flammability issues
- Compatible with Pb-free solders and wire bonding (Au and Al)
- Possibility to print circuits directly on heat sink (even non-planar)

Heraeus has established this technology and offers a comprehensive concept for optimal thermal management. Basically, the heat generated by the chip can be spread to eliminate the punctual thermal load coming from the semiconductor. Series of tests have confirmed that the technology is up to par with ceramic boards by lower costs and reel to reel manufacturing capabilities.

**Thermal and Electrical Vias in Multilayer Substrates**

- New via technology for reel to reel process
- Imprinted Cu-layer is laser welded to the bottom layer
- Standard via size 0.4 mm
- Proportional size of thermal and electrical pads
- Various electrical conductive layers allow more complex circuits

**Stamped Circuit Boards (SCB)**

Stamped Circuit Board technology allows a highly innovative and sophisticated substrate solution for LED packages. It permits the structuring and lamination of metal-plastic foil combinations on a high efficient mass production scale.

In the manufacturing process both the plastic and the metal are initially structured on separate reels according to customer specific requirements. The materials are subsequently laminated with high precision. Unlike any other process this technology allows a highly efficient structuring of an insulating plastic layer, which is as an ideal basis for LED packages.

Heraeus CoolStrates™ are customized boards, combined modules of Celcion™ on Al substrates. These materials are primarily used in the field of high power LED Substrates, Concentrated Photovoltaics, Power Electronics and Heaters.

Heraeus CoolStrates™

- Superior thermal management
- Long lifetime and high reliability
- Color stability of lighting
- Ul recognized

400 µm coined and laser welding

Multilayer stripe design

400 µm

1. LED PACKAGE
2. LED MODULE
3. Interface Materials
4. Solder and solder pastes
5. Adhesives
6. THICK FILM BOARD SYSTEM
7. Heraeus CoolStrates™
8. Al heat sink
9. Aluminum board
10. Dielectric layer
11. Thermally conductive tape
12. Ag conductor
13. Solder
14. LED package
15. Cu foil
16. Electrically conductive tap
17. Ag paste
18. Solder
19. LED die
20. Au wire
21. Aluminum board
22. Solder mask
Interconnect

Heraeus offers a wide selection of bonding wire types for ball bonding and stub bumping in the LED assembly. Traditionally, gold wire has always been the primary choice of selection. However, with the increasing drive for cost reduction, alternate bonding wire types have been successfully developed and qualified to provide end users with a wider range of selection. Each wire’s characteristics can be adjusted individually to the specific purpose.

Gold Bonding Wires
- Robust bonding with large bonding window
- High strength and excellent loop stability
- Best reliability performance

Gold Alloy Bonding Wires
- Low cost alternative
- Comparable bonding performance with gold wire

Silver Alloy Bonding Wires
- Low cost alternative
- Good reflectivity surface

Copper Alloy Bonding Wires
- Lowest cost material
- High strength and excellent loop stability

Coated Copper Bonding Wires
- Low cost alternative
- High strength and excellent loop stability

Contact Materials for LED Assembly

Materials for LED Die Attaching
As a leading supplier of die attach materials Heraeus offers a big variety of products with tailored properties for LED attach on chip carriers. The low to mid power LEDs industry are served by our well established conductive adhesive for many years. High power LEDs or multichip modules require an advanced higher thermal conductivity and thermal stability of the die attach materials. Operation temperatures up to 100°C can be covered by conventional SAC solder, but for advanced reliability and higher LED operation temperatures Heraeus developed and qualified halide free, lead free solder pastes so called InnoRel Products (Innolot and HT1). Additionally, our innovative mAgic Sinter Paste will lead to improved life time and reliability of LED device by providing outstanding electrical and thermal conductivity. These properties of our novel sintering materials guaranty a longer operation time not only for high power but also for standard LEDs because of excellent heat transfer.

Sputtering Targets

Heraeus manufactures state-of-the-art high purity sputtering and evaporation materials for various applications in Electronics, Large Area Coating, and Magnetic Data Storage. We are a globally competent partner for customer-specific coating solutions due to our comprehensive technological expertise and our global network of development centers, production facilities and sales locations. Our strength in precious metals, Heraeus is ready to support the high purity and high volume demands of the LED industry, as well as the specific requirements necessary for good heat dissipation or corrosion resistance of an LED.

Silver alloys, which can work as corrosion resistant reflectors in LEDs, are examples of some of the materials used as sputtering targets or slugs. The increasing demand in thermal management is addressed by gold bonding alloys such as AuSn, which are well proven as die attach materials, and WTi sputtering materials, used for barriers.

Our customers from the LED industry rely on the material knowledge of Heraeus sputtering target materials that results from supporting the production of electronic components for more than 30 years.

Challenge
- Heat dissipation with optimized layers
- Application of a reflective coating for protection against high temperatures and corrosion

Solution
- Heraeus employs state of the art manufacturing facilities for Au, AuSn, AuGe, Ag, Pt, WTi and Sn targets, as well as for evaporation material
- Heraeus silver alloys demonstrate excellent corrosion protection and a high reflectance
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