PRODUCT Application Notes

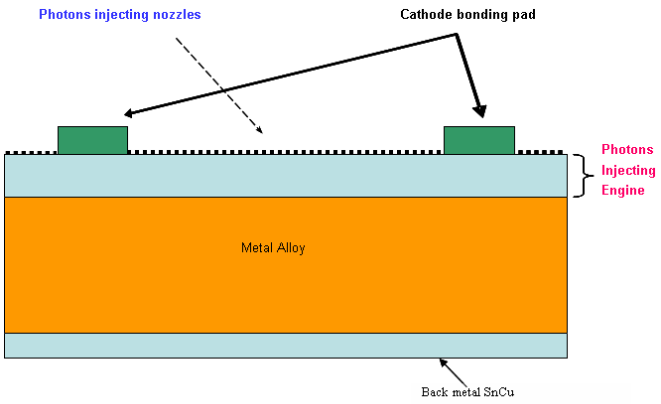
MvpLED™ Handling and Package Notes (Back metal SnCu)

Introduction

SemiLEDs' Metal Vertical Photon Light Emitting Diode (MvpLED™) devices are fabricated using SemiLEDs' proprietary and patent pending process technologies. These are the next generation of Ultra-High Brightness LEDs (UHBLED) for advanced applications, including solid-state lighting. SL-V-X40EC LED chips have many excellent properties, including high thermal conductivity, high brightness and good reliability. These chips are fabricated with SnCu 99.3:0.7 anode contact on the bottom of the metal alloy substrate. It is recommended that package manufacturers handle the chip carefully to achieve the best performance. This application note gives some basic guidelines for packaging the SL-V-X40EC LED.

How to get the best performance from SL-V-X40EC LED

The SL-V-X40EC LED chips can be divided into three parts: a metal alloy substrate, photon injection engine, and photon injecting nozzles. The metal alloy substrate is relatively soft when compared to other common substrates for InGaN chips, and the photon injection engine and photon injecting nozzles are also fragile. According to the different mechanical properties of these parts, the user should handle with care to prevent large localized stress on the chip during the packaging process. Avoid using tweezers when handling. If the usage of tweezers is unavoidable, avoid direct contact of the tweezers to the surface of the chip and the edge of the junction. Large localized stress may damage the photon injecting nozzles or the photon injection engine, leading to increased device leakage and reduce optical light output.



Die Attach Process

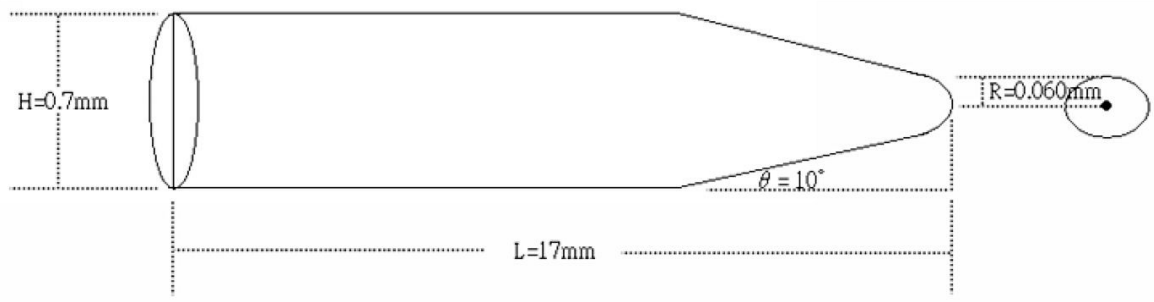
Die Attach (also known as Die Bond or Die Mount) is the process of attaching the LED chip to the die pad of the lead frame of the package. The following guidelines must be implemented:

The key factors are: Automatic Operation

1. Dimension of the ejection needle: The dimension of the ejection needle should be of proper size:

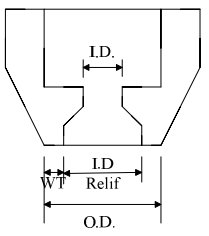
Type	p-n Junction Height (μm)	Base Area (μm x um)	Dimension of push-up needle (Radius: mm)
SL-V-X40EC	140 ± 15	1070x1070	R≧0.1

Note: "X" represents the spectrum range of the chip. "U" for UV, "B" for Blue and "G" for Green.



2. Pick-and-place

(1) Tool: We recommend using an anti-static plastic tool which is made of rubber. Do not use pick-up tools made of hard materials, such as tungsten carbide or steel, these may cause mechanical damage to the chip.

Type	p-n Junction Height (μm)	p-n Junction Area (μm x μm)	Outer dia (O.D., mm)	Wall thickness (W.T., mm)	Internal Dia (I.D., mm)	I.D. Relief (mm)	
SL-V-X40EC	140 ± 15	970x970	1.524	0.225	0.7	0.1024	

(2) Delay time: Lower suction force is better for MvpLED chips. The following example shows the different delay times.

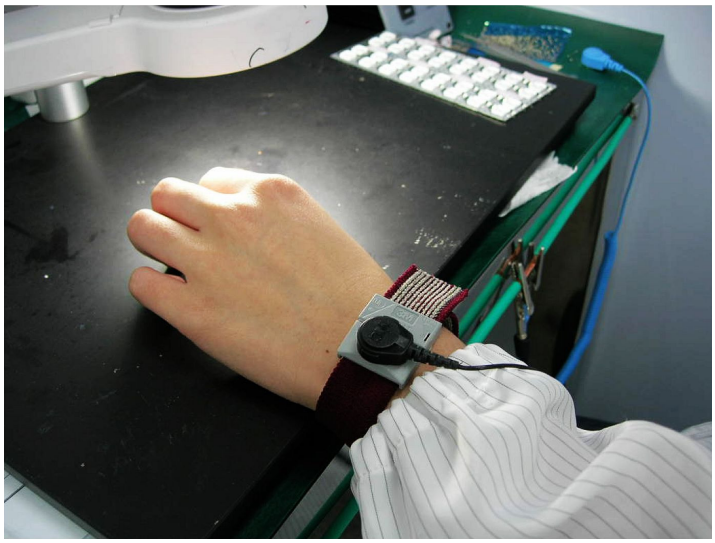
Type	p-n Junction Height (μm)	p-n Junction Area (μm x μm)	Delay time for pick (msec)	Delay time for push-up (msec)	Delay time for place (msec)
SL-V-X40EC	140 ± 15	970x970	50	30	20

The key factors are: Manual Operation

1. The amount of adhesive (Ag epoxy or solder): Although the junction height is 75~140µm, too much adhesive will cause the p-n junction to short. The following table shows the dimensions of the chips.

Type	p-n Junction Height (µm)	Base Area (µm x µm)	p-n Junction Area (µm x µm)
SL-V-X40EC	140 ± 15	1070x1070	970x970

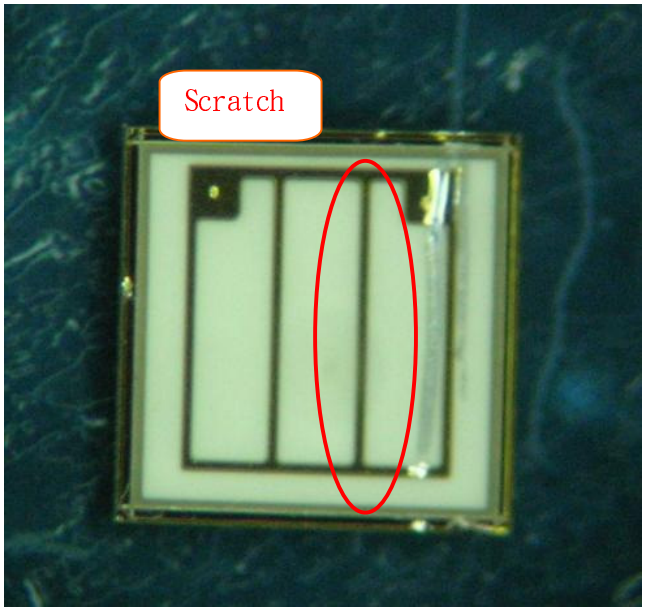
2. Use wrist bands or anti-electrostatic gloves when handling the chips. This is a precautionary measure to prevent chips from future or possible ESD damages.



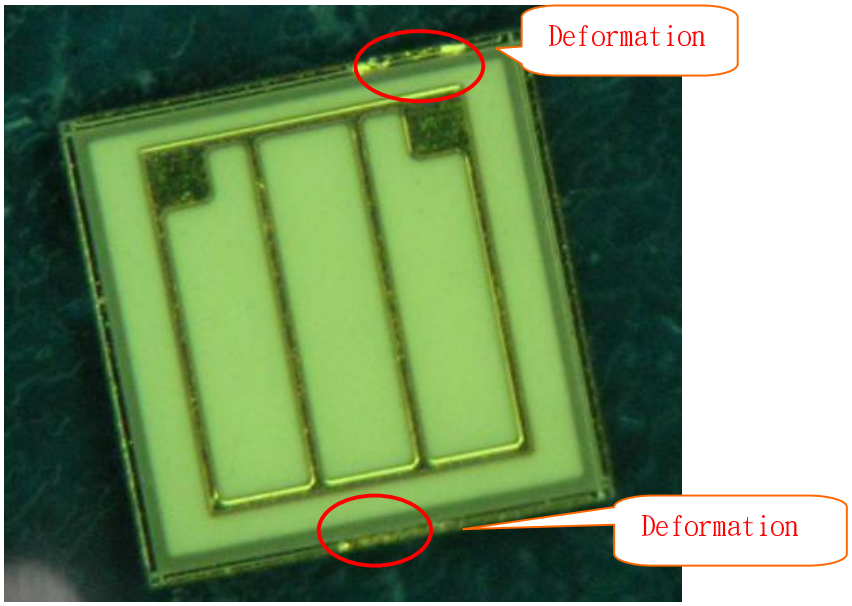
3. Use an ionic fan to prevent chips from future or possible ESD damages.

4. The blue tape should be peeled from the release paper in front of an ionic fan.

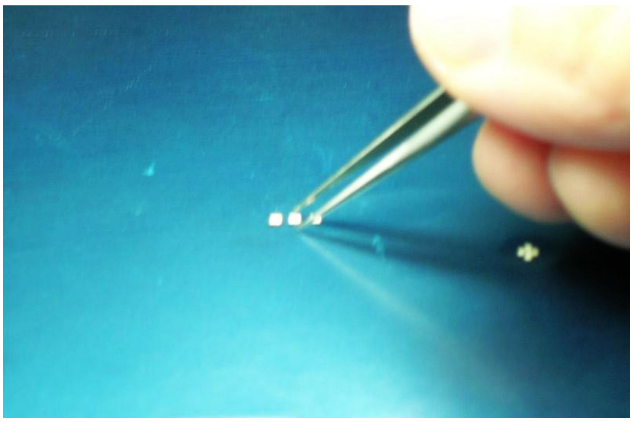
5. Check the tweezers. The tips of the tweezers should be in good shape. If the tips are bent, the operation will be more difficult, and the chip may get scratched during the pick-up step.



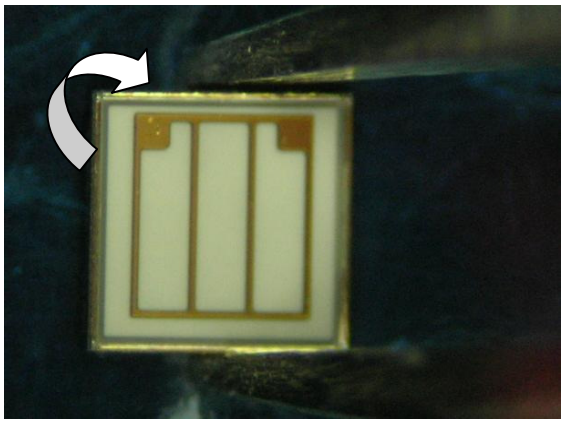
6. The metal alloy substrate of the MvpLED™ is softer than sapphire, therefore a small pick-up force should be used to prevent deformation of the chip.



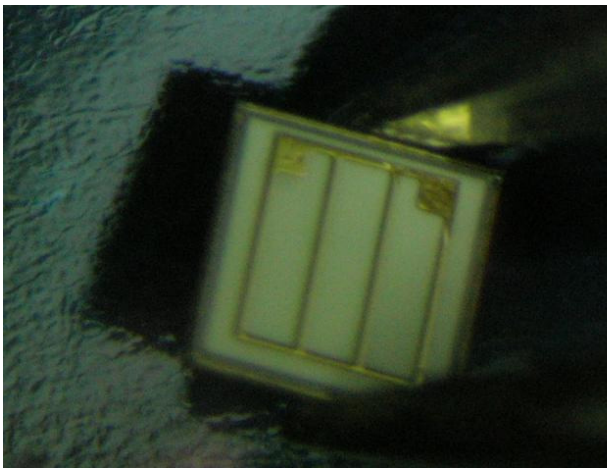
7. Clip the chip and then rotate the chip clockwise. It is very important to make sure that the chip is lifted off of the blue tape before picking up the chip. If the operator picks up the chip without this rotating step, it is easy to scratch the chip. The hard material would damage the semiconductor layer and cause leakage or potential leakage issues.



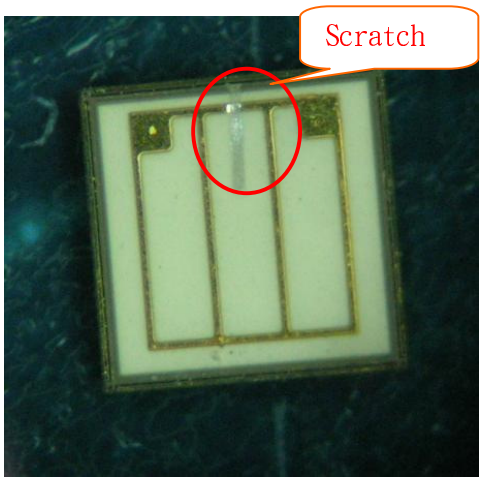
a. Clip the chip with small force.



b. Rotate the chip clockwise



c. Make sure that the chip is lifted off of the blue tape. Then, pick up the chip.

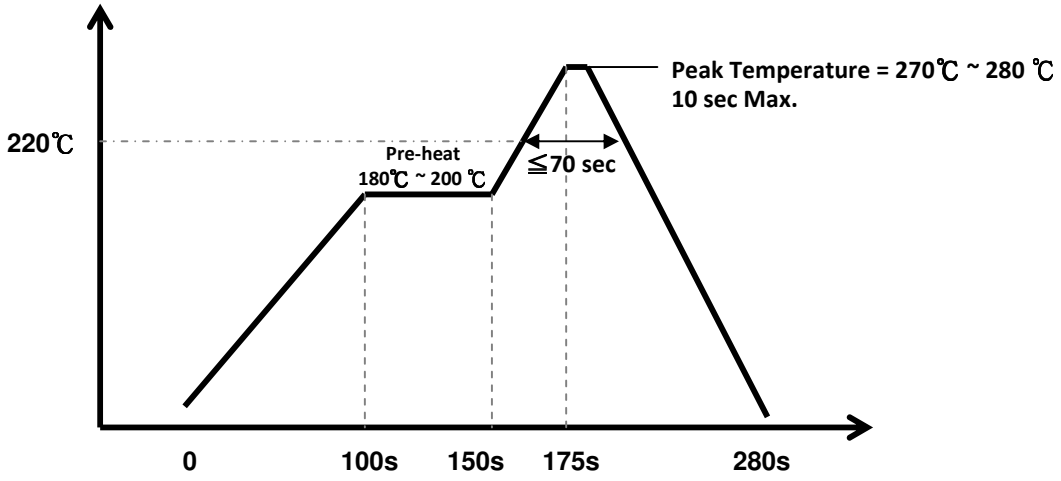


d. The tweezers can scratch the surface of the chip when the chip is not clipped and rotated correctly.

8. Put the chip onto the die pad of lead frame. The silver paste can't overflow and contaminate the chip surface.
9. Do not use the tip of the tweezers to press the front surface of the chips.
10. Do not scratch the edge and/or front side of the chips.

Recommendations for Eutectic Process:

(1) The peak temperature of the reflow process should be 30-50℃ above the melting point of the contact metal – for SnCu 99.3:0.7 contact metal the peak reflow temperature should be between 270-280℃. The following Lead-free reflow temperature profile shows the eutectic reflow profile used for SL-V-X40EC chips with SnCu contact metal. It is recommended that temperature profiles be verified by direct measurement at the LED chip to ensure that the maximum process limits are not exceeded.



(2) Only no-clean flux should be used in the flux-eutectic reflow process. SemiLEDs has evaluated the following flux brands which give compatible results (the surface of lead frame is Silver):

- AIM NC257, AIM Co. , Canada
  http://www.aimsolder.com, TEL:+1-514-494-2000
- Dyfenco AIM254, DYFENCO Electronic Chemical Co. Ltd.（岱暉電子化學股份有限公司）, http://www.dyfenco.com, TEL: +886-7-616-0317

The appropriateness of alternative fluxes should be evaluated by the customer.

(3) Flux residue should be cleaned in (a) isopropyl alcohol (IPA) or (b) Kyzen MicroNox MX2302 @60℃ /5~15min and optimized for the clean process for mass-production. Alternative liquid cleaning processes may be suitable but must be thoroughly evaluated for compatibility with the SL-V-X40EC chips. If alternate fluxes and clean processes are used, the customer should consult the flux supplier and be evaluated by the customer. If plasma cleaning is a customer consideration, SemiLEDs recommends the chips not be exposed to hydrogen plasmas. The Hydrogen plasma cleaning process is not a SemiLEDs recommended process.

- MicroNox MX2302, Kyzen Co., US, TEL: +615-831-0888, http://www.kyzen.com

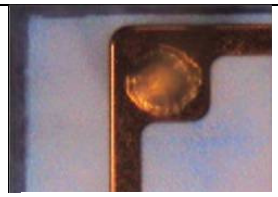
The appropriateness of alternative clean processes should be evaluated by the customer.

(4) Minimal pressure should be applied to the SL-V-X40EC chips during eutectic reflow process. Pressure eutectic process is not a SemiLEDs recommended process; however, if the customer selects this process, then a maximum pressure force of 50 gf is recommended.

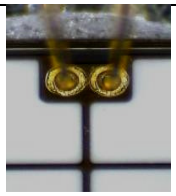
Wire Bond Process

We recommend using gold ball bonding as an electrical connection. A gold ball is first formed by melting the end of the wire through electronic flame-off (EFO). Then free-air ball is brought into contact with the bond pad on the chip. The bonder applies pressure, heat, and ultrasonic force to the ball to form a metallurgical weld between the ball and the bond pad. Then the wire is run to the lead frame, forming a loop between the bond pad and the lead frame. Pressure and ultrasonic force are applied to the wire to form the second bond.
The bonding force of the first bond should have a lower force, a lower power and be fine tuned to prevent stress from damaging the bond pad and chip. The gold ball can't bond over the pad area; it will damage the semiconductor layer and cause current leakage. The following example shows the parameters for wire bonding.

Parameters	First bond (N-Pad)
Bond time (ms)	10
Power (Dac)	70
Force (gf)	30



SL-V-B45AC chip



SL-V-B45AK chip

Encapsulation Materials

Packaged LED lifetime is not only determined by the chip but also through other materials, like the encapsulation material. Silicone resin together with blue and green MvpLEDs show many advantages such as lifetime, brightness, etc…. For shorter wavelength MvpLED UV chips, a glass cover sealed with nitrogen gas is recommended.

Important Note: Most silicone encapsulants available in the market are compatible with MvpLEDs. However, in-house tests showed that certain additive material will damage the MvpLED's passivation and cause leakage current or increase the risk of leakage current. SemiLEDs recommends customers prevent the use of those silicone encapsulants. We will continue to test the compatibility of other silicone encapsulants and provide notifications on our website. Currently, silicone such as Momentive corp. 1063, Dow corning corp. OE-6636, and OE-6450 are qualified as encapsulant materials. If the customer has any concerns over encapsulant selection; SemiLEDs will test and confirm upon the customer's request. Within this enquiry, the customer needs to include the manufacturer and part number of the silicone encapsulants.

Soldering

After packaging and in assembly, it is recommended to avoid hand soldering. Either reflow process or solder paste (for low process temperature, customer could use low melting point solder, e.g. Sn/Bi solder) with hotplate baking is recommended.

Recommended:

Reflow oven

Hotplate

Avoid:

Hand soldering

ESD Protection

Electrostatic discharge (ESD) may also damage chips. The following precautions may help prevent chips from future or possible ESD damages.

- All equipment must be properly grounded.
- Use wrist bands or anti-electrostatic gloves when handling the chips.
- Use an ionic fan in chip transfer and other process, to prevent chips from future or possible ESD damages.
- It is recommended to build a protection component into the emitter or the module, for example, a zener diode.

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About Us

SemiLEDs Corporation is a US manufacturer of ultra-high brightness LED chips with state of the art fabrication facilities in Hsinchu Science Park, Taiwan. SemiLEDs specializes in the development and manufacturing of vertical LED chips in blue (white), green, and UV using a patented copper alloy base. This unique design allows for higher performance and longer lumen maintenance. In December 2008, The World Economic Forum recognized SemiLEDs innovations with the 2009 Technology Pioneer Award. SemiLEDs is fully ISO 9001:2008 Certified

SemiLEDs is a publicly traded company on NASDAQ Global Select Market (stock symbol "LEDS"). For investor information, please contact us at **investors@semileds.com**.

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