PRODUCT Application Notes

MvpLED™ Handling and Package Notes (Back metal Au)

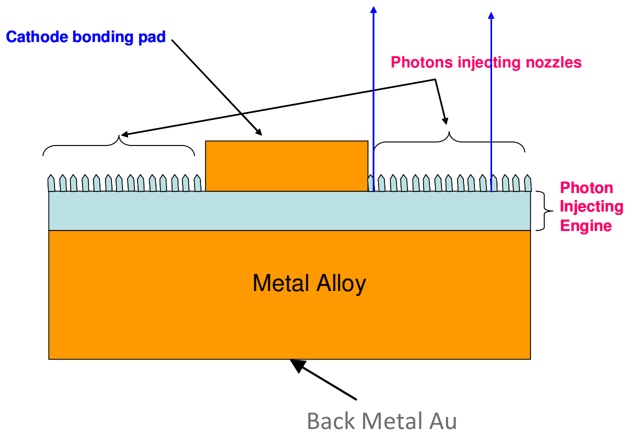
Introduction

SemiLEDs' Metal Vertical Photon Light Emitting Diode (MvpLED™) devices fabricated using SemiLEDs' proprietary and patent pending process technologies. These are the next generation of High Brightness LEDs (HBLED) for advanced applications, including solid state lighting.

MvpLED™ chips have many excellent properties, including high thermal conductivity, high brightness, and good reliability. Package manufacturers need to be careful in handling to get the best performance from the chips. This manual application note gives a basic guideline for packaging the MvpLED™.

How to get the best performance form MvpLED

The MvpLED™ chip can be divided into three parts: metal alloy, photon injection engine, and photon injecting nozzles. The metal alloy is soft, and the photon injection engine and photon injecting nozzles are fragile. According to the different mechanical properties of these parts, the user should be very careful to prevent large local stress on the chip during the packaging process. If there is any large local stress, it may damage the photon injecting nozzles or the photon injection engine.



Die Attach Process

Die Attach (also known as Die Bond or Die Mount) is the process of attaching the LED chip to the contact pad of the lead frame in the package. There are three main steps of the die attach process. In the first step, chip adhesive via solder paste or solder is dispensed on to the contact pad. Then, the die is ejected from the wafer tape by a push-up needle which pushes upward on the backside of the die and dislodges the die off the wafer tape. In the third step, a pick-and-place tool picks the die from the wafer tape and positions it on the dispensed solder.

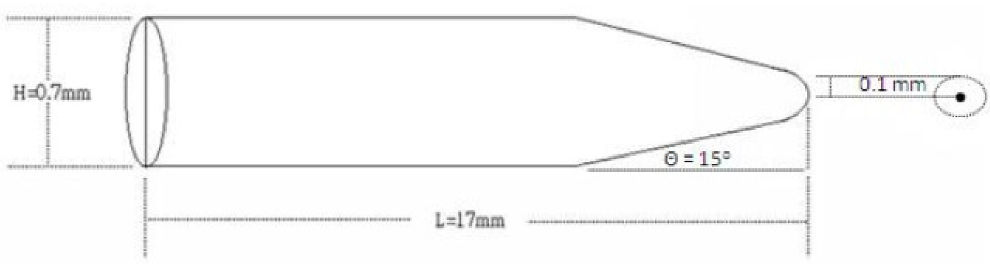
The key factors are: Automatic Operation

1. Tool Material: The antistatic plastic-made material is recommended rather than the metal-made hard material for the push-up needle. The push-up needle made by the hard material may cause mechanical damages to the chip.
2. The amount of the adhesive (Ag epoxy or solder): Although the junction height is 75~140μm, too much adhesive will cause the p-n junction to short.
3. Dimension of the push-up needle: The dimension of the push-up needle should fit the chip. The following example shows the different dimensions of the push-up needles used for different types of chips.

Type	Material	p-n Junction Height (μm)	Backside Area (μm x um)	Dimension of push-up needle (Radius: mm)
SL-V-X15A□	Plastic	75 ± 15	380x380	R≦0.1
SL-V-X24A□	Plastic	90 ± 15	610x610	R≦0.1
SL-V-X28A□	Plastic	90 ± 15	720x720	R≦0.1
SL-V-X35A□	Plastic	90 ± 15	860x860	R≧0.1
SL-V-X40A□	Plastic	140 ± 15	1070x1070	R≧0.1
SL-V-X45A□	Plastic	140 ± 15	1200x1200	R≧0.1
SL-V-X60A□	Plastic	140 ± 15	1520x1520	R≧0.1

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

Example: where in the R=0.1



4. Pick-and-place
   (1) Tool: We recommend using an antistatic plastic tool which is made of rubber. Do not use pick-up tools made of hard materials like tungsten carbide or steel, these kinds of tips may cause mechanical damage to the chip. The following example shows the different dimensions of rubber collects to be used for different types of chips.

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-X15A□	75 ± 15	340x340	0.4	0.1	0.2	-	Materials : Rubber
SL-V-X24A□	90 ± 15	550x550	1.27	0.335	0.6	-	
SL-V-X28A□	90 ± 15	640x640	1.27	0.335	0.6	-	
SL-V-X35A□	90 ± 15	800x800	1.524	0.225	0.7	0.1024	
SL-V-X40A□	140 ± 15	970x970	1.524	0.225	0.7	0.1024	
SL-V-X45A□	140 ± 15	1050x1050	1.524	0.225	0.7	0.1024	
SL-V-X60A□	140 ± 15	1520x1520	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 used for different types of chips.

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-X15A☐	75 ± 15	340x340	30	30	20
SL-V-X24A☐	90 ± 15	550x550	30	30	20
SL-V-X28A☐	90 ± 15	640x640	30	30	20
SL-V-X35A☐	90 ± 15	800x800	30	30	20
SL-V-X40A☐	140 ± 15	970x970	60	60	20
SL-V-X45A☐	140 ± 15	1050x1050	60	60	20
SL-V-X60A☐	140 ± 15	1420x1420	60	60	20

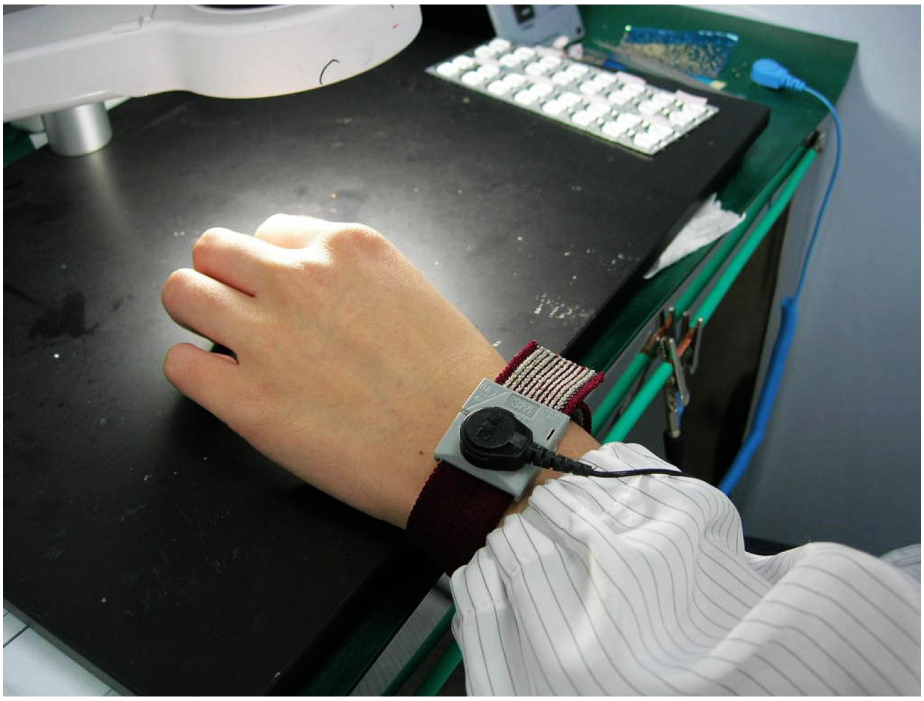
5. **Height parameter setting: Improper push-up tip and collect height setting may cause the damage on the chip. Herewith showing the example of the proper parameter setting by ASM AD model series.**
   a) **Collect height: Let the collect touch the chip surface first and the then lift the collect height by additional 25um.**
   b) **Push-up tip height: Let the push-tip touch the blue tape first and then lift the tip height by additional 400um.**

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 short. The following table shows the dimensions of the chips.

Type	p-n Junction Height (µm)	Backside Area (µm x µm)	p-n Junction Area (µm x µm)
SL-V-X15A☐	75 -10/+15	380x380	340x340
SL-V-X24A☐	90 ± 15	610x610	550x550
SL-V-X28A☐	90 ± 15	720x720	640x640
SL-V-X35A☐	90 ± 15	860x860	800x800
SL-V-X40A☐	140 ± 15	1070x1070	970x970
SL-V-X45A☐	140 ± 15	1200x1200	1050x1050
SL-V-X60A☐	140 ± 15	1520x1520	1420x1420

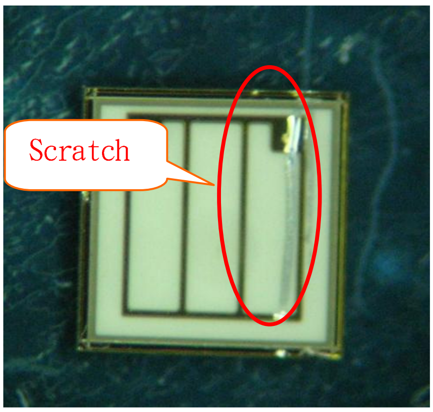
2. Use wrist bands or anti-electrostatic gloves when handling the chips. This is a precautionary measure to prevent chips from future or possible ESD damage.



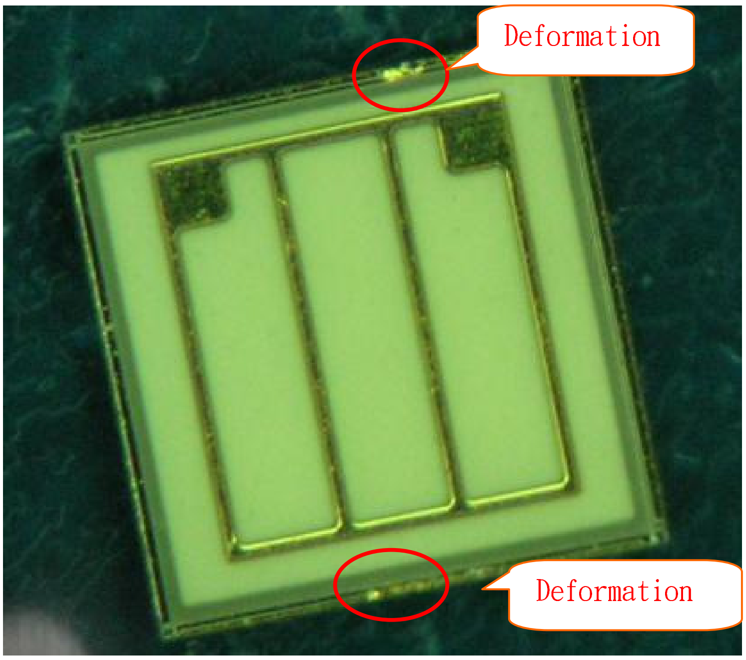
3. Use an ionic fan to prevent chips from future or possible ESD damage.

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

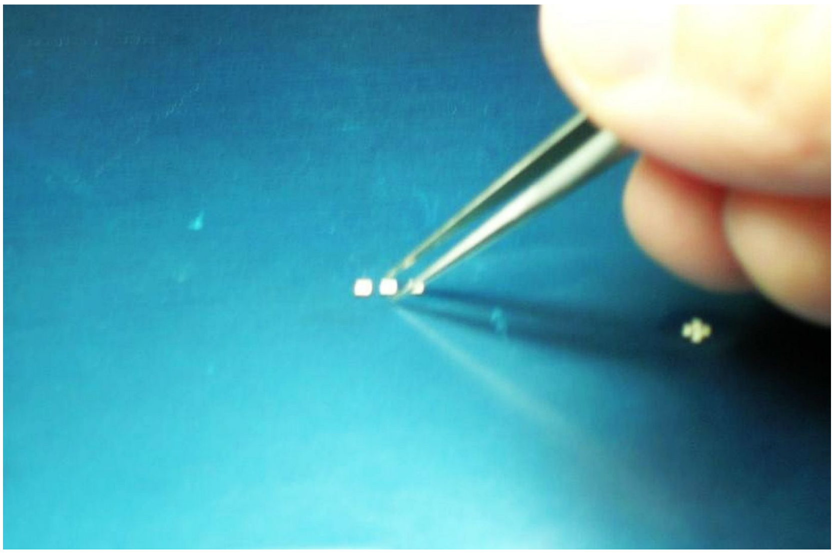
5. Check the tweezers. The tips of the tweezers should be in good shape. If the tips are bent, the operation will be more difficult, and the chip may get scratched during the pick-up step.



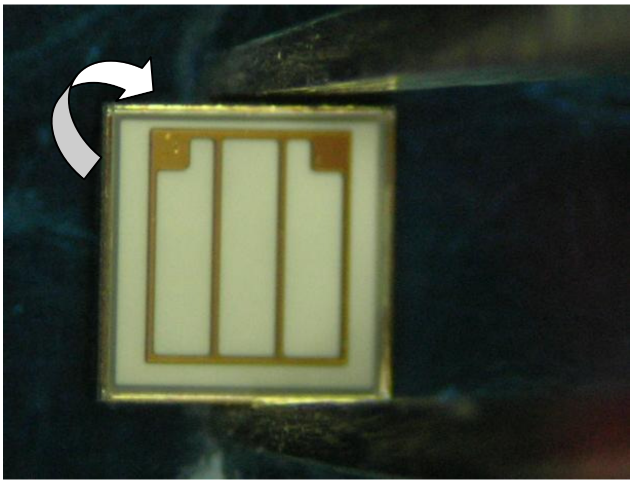
6. The metal alloy of SemiLEDs' MvpLED™ is softer than sapphire, therefore a small pick-up force should be used to prevent deformation of the chip.



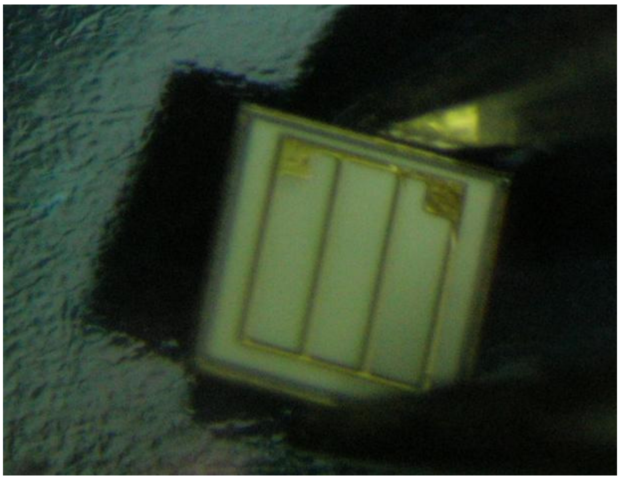
7. Clip the chip by a tweezer with the incident angle of 45 deg. and then rotate the chip clockwise. It is very important to make sure that the chip is lifted off of the blue tape before picking up the chip. If the operator picks up the chip without this rotating step, it is easy to scratch the chip.



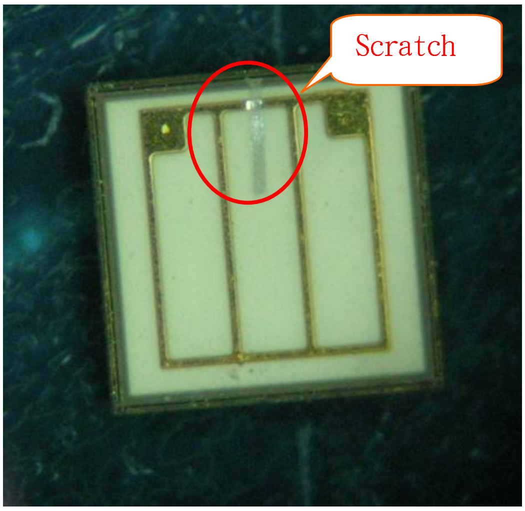
a. Clip the chip with small force.



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 chip when the chip is not clipped and rotated correctly.

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

Note:

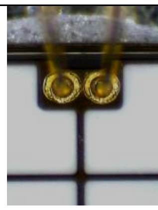
In your packaging processes, long steady high temperature will affect LED and other relative material’s quality. (Such as forward voltage increase, luminance decrease). Lower temperature and shorter duration are recommended. As an than 3 hours at 180℃.

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 processes, to prevent chips from future or possible ESD damage.
- 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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