# LOCTITE STYCAST OS 5101 DATA PACKAGE

Henkel Shanghai | June 2021

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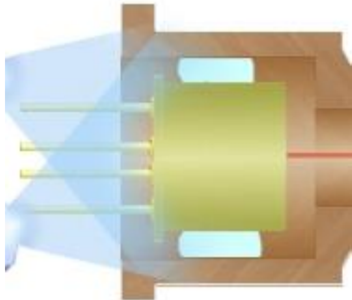
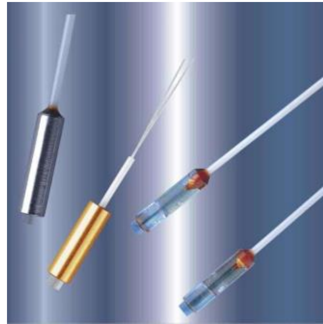
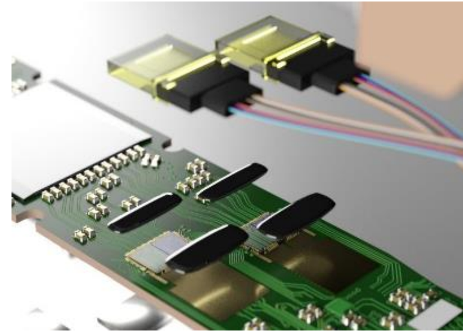
# 1. PRODUCT APPLICATION

- To manage the greater data bandwidth needs, next-generation cloud hyperscale datacenters are transitioning to the 400 gigabit ethernet (GbE) standard. 100G and 400G transceivers are the mainstream optical modules being deployed in data centers.
- Active Alignment (AA) adhesive is widely used in optical market for active alignment and bonding of transceiver lens, OSA filter, silicon photonics assembly and passive component assembly such as collimator lens bonding.

# 1. PRODUCT APPLICATION

- Henkel LOCTITE STYCAST OS 5101 is a **low shrinkage, high Tg, low CTE, dual cure** (UV/thermal) adhesive.
- It can be used for TO-CAN pre-fix, lens, fiber, glass, and other optical components requiring active alignment.
- *It can also be used on any application which need alignment and pre-fixing.*

# 2. PHYSICAL PROPERTY

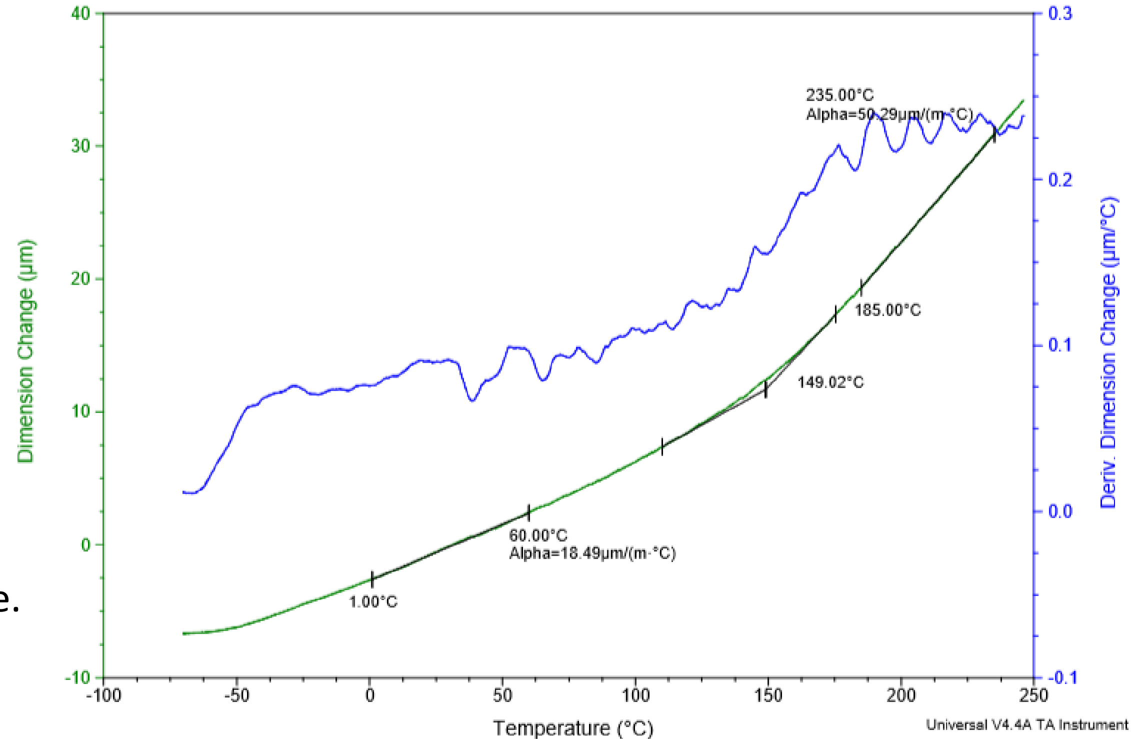
| Item | | OS 5101 |
|---|---|---|
| Technology | Test method | Epoxy cation |
| Filler size | | average ＜10um, maximum 25um |
| Viscosity @20 $s^{-1}$ @25℃ | Physical, 200um gap | 17000~27000 mPa.s |
| Thixo Index | 2/20 $S^{-1}$ | ＞=1.5 |
| Work life @ RT | | 24h |
| Shelf life | | 6 month @ -20℃ |
| Ion content | $F^-$ | NA |
| | $Cl^-$ | NA |
| | $Na^+$ | ＜10ppm |
| | $K^+$ | NA |

# 2. PHYSICAL PROPERTY

| Item | Test method | Parameter | OS 5101 |
|---|---|---|---|
| Volume shrinkage | Henkel method | | ~1% |
| Water absorption | 85C/85RH%/500h | | 0.8% |
| Tg (℃) | TMA | | 137 |
| CTE (ppm/℃) | TMA | below Tg | 20 |
| | | above Tg | 56 |
| Tensile modulus (MPa) | DMA | -40℃ | 17577 |
| | | 25℃ | 14281 |
| | | 100℃ | 11340 |
| | | 150℃ | 8975 |

# 2. PHYSICAL PROPERTY

CTE/TG




**Test method/procedure:**

1. Equipment: TMA
2. -70/+250℃ temperature range;
3. CTE is variable with temperature.

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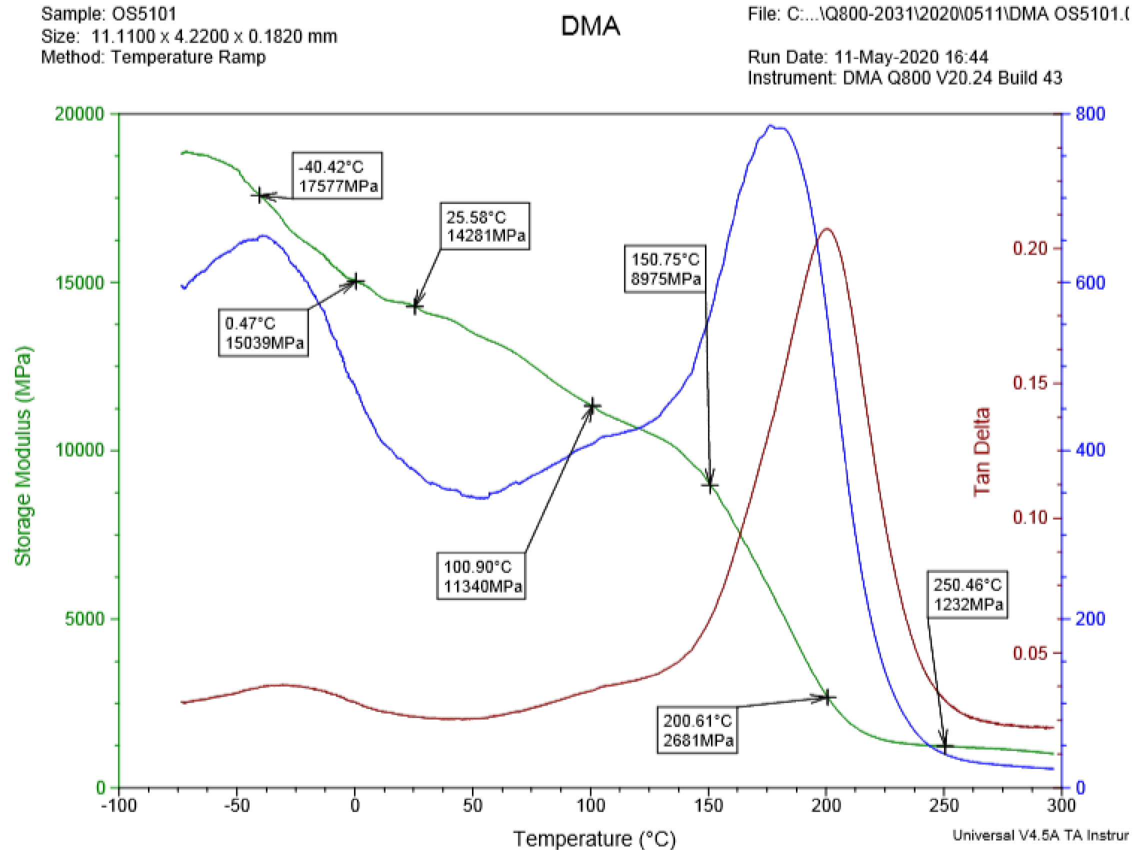
# 2. PHYSICAL PROPERTY

## MODULUS




### Test method/procedure:

1. Equipment: DMA
2. Tension test method
3. -65/+300℃ temperature range;

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# 2. PHYSICAL PROPERTY

## SHRINKAGE

### Linear and Volumetric Test Report Form
### ATM-0098

| | Results |
|---|---|
| Density of uncured adhesive (U) from ATM-0001 : | 1.834 g/ml |
| Density of cured adhesive (C) from ATM-0060 or ATM-0109 : | 1.846 g/ml |
| Weight loss on cure (W) from ATM-0031 : | 0.200 % |
| Linear Shrinkage (%) : | 0.284 % |
| Volume Shrinkage (%) : | 0.849 % |

$$\text{Linear Shrinkage (\%)} = 100\left(1 - \sqrt[3]{[(100-W)/C \div 100/U]}\right)$$

$$\text{Volume Shrinkage (\%)} = 100 \times \left(1 - [(100-W)/C \div 100/U]\right)$$

Cured sample density tester

Uncured sample density tester

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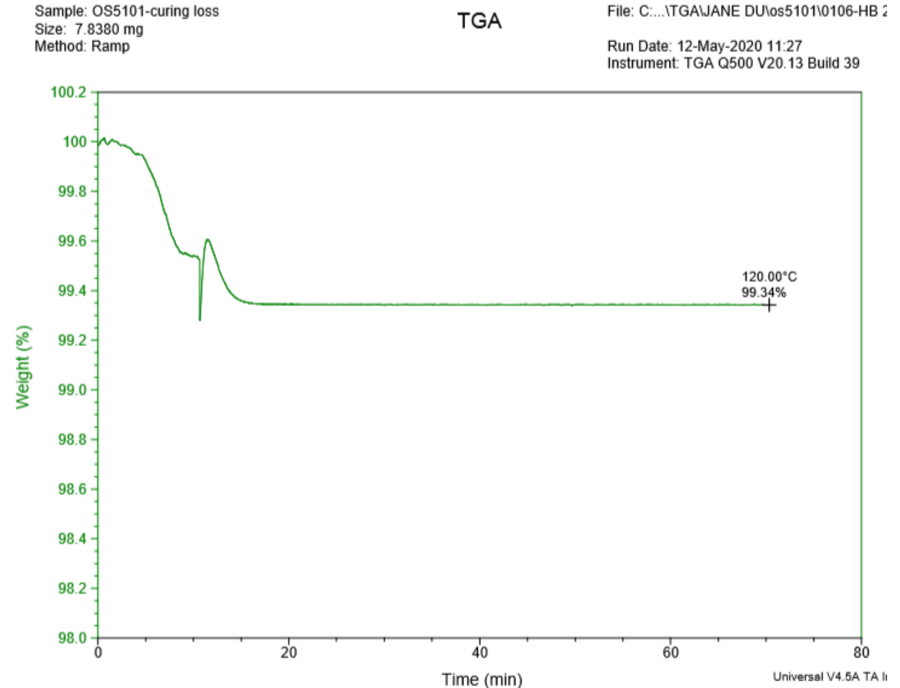
# 2. PHYSICAL PROPERTY

## OUTGASSING DURING **HEAT** CURING (NO UV)

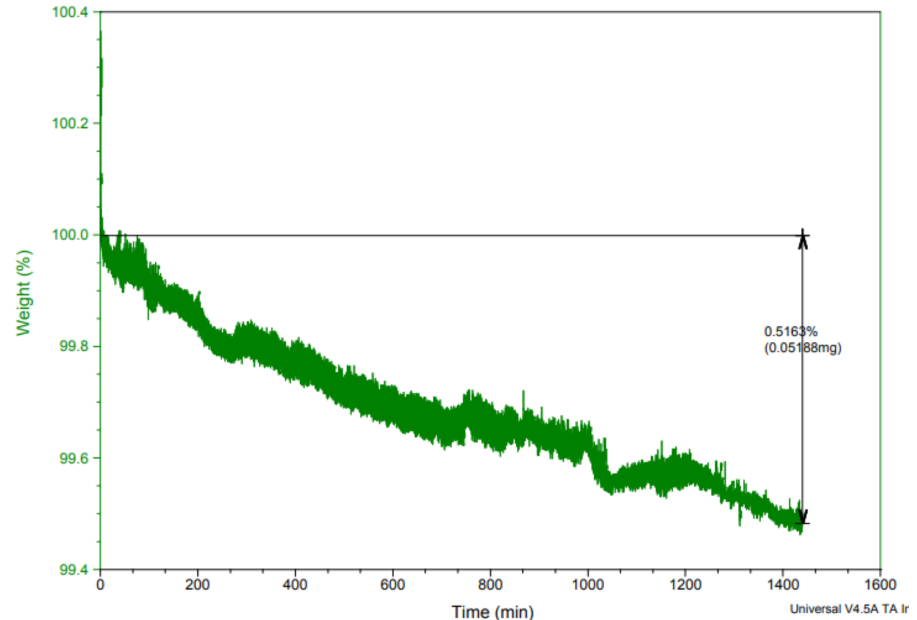
- OS 5101 only cured at 120℃/60min through TGA instrument.
- **Outgassing is less than 0.7% during only thermal curing.**



# 2. PHYSICAL PROPERTY

## OUTGASSING AFTER UV AND HEAT CURING

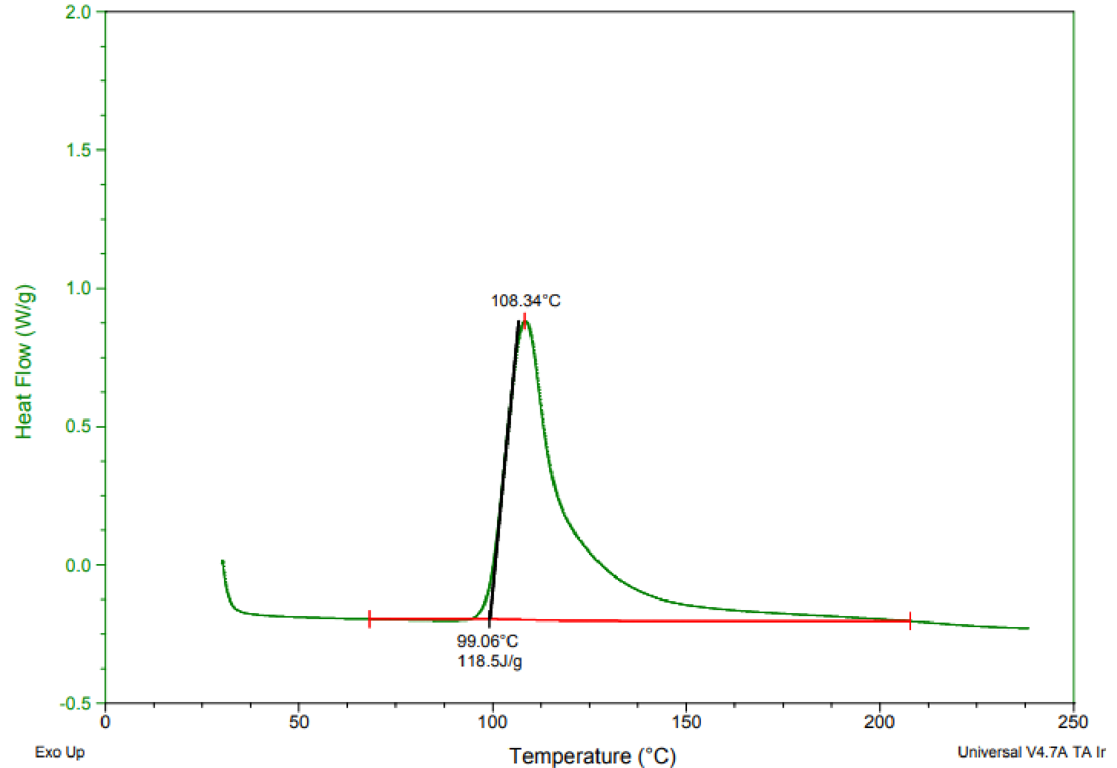
- OS 5101 curing condition: UV+120°C/60min. Then put into TGA equipment to do outgassing test.
- Test profile: 10°C/min, RT to 120°C, isothermal 24h.
- **Outgassing is lower than 0.6% after UV and heat curing.**



# 3. CURE PROFILE STUDY

## DYNAMIC DSC

- Onset temperature: 99℃
- Peak temperature: 108℃

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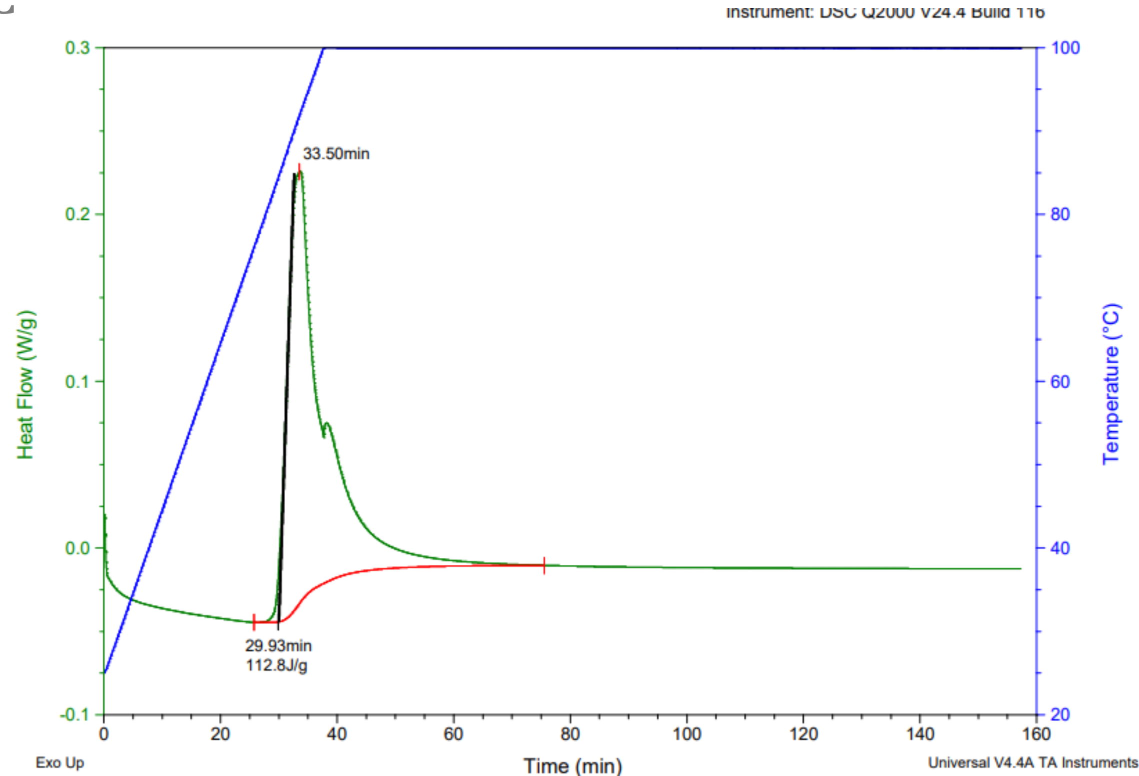
# 3. CURE PROFILE STUDY

## ISOTHERMAL DSC @ 100℃

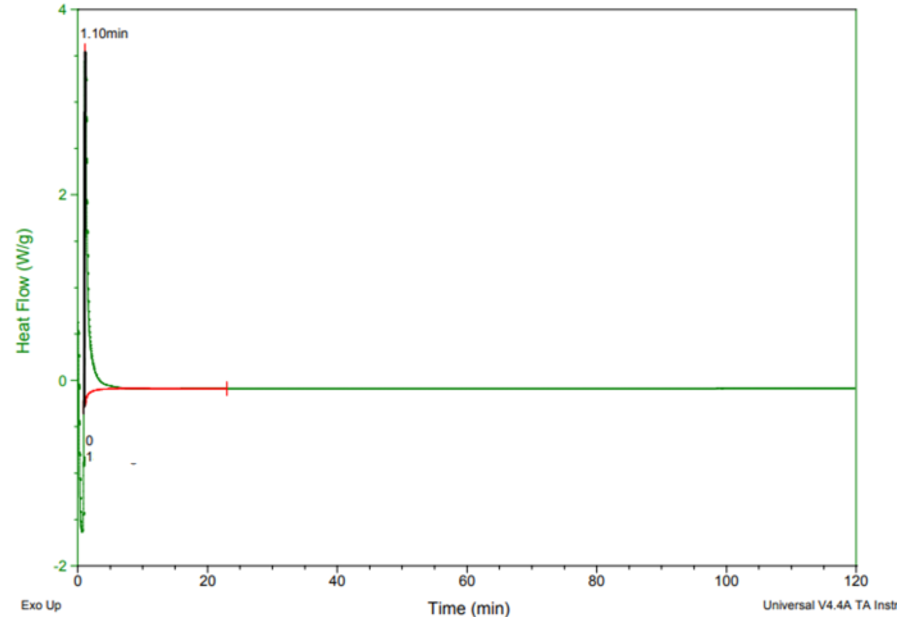
- **OS 5101 can cure completely at 100℃/90min.**
- To reach stable adhesion performance, longer curing time is suggested.



# 3. CURE PROFILE STUDY

## ISOTHERMAL DSC @ 120℃

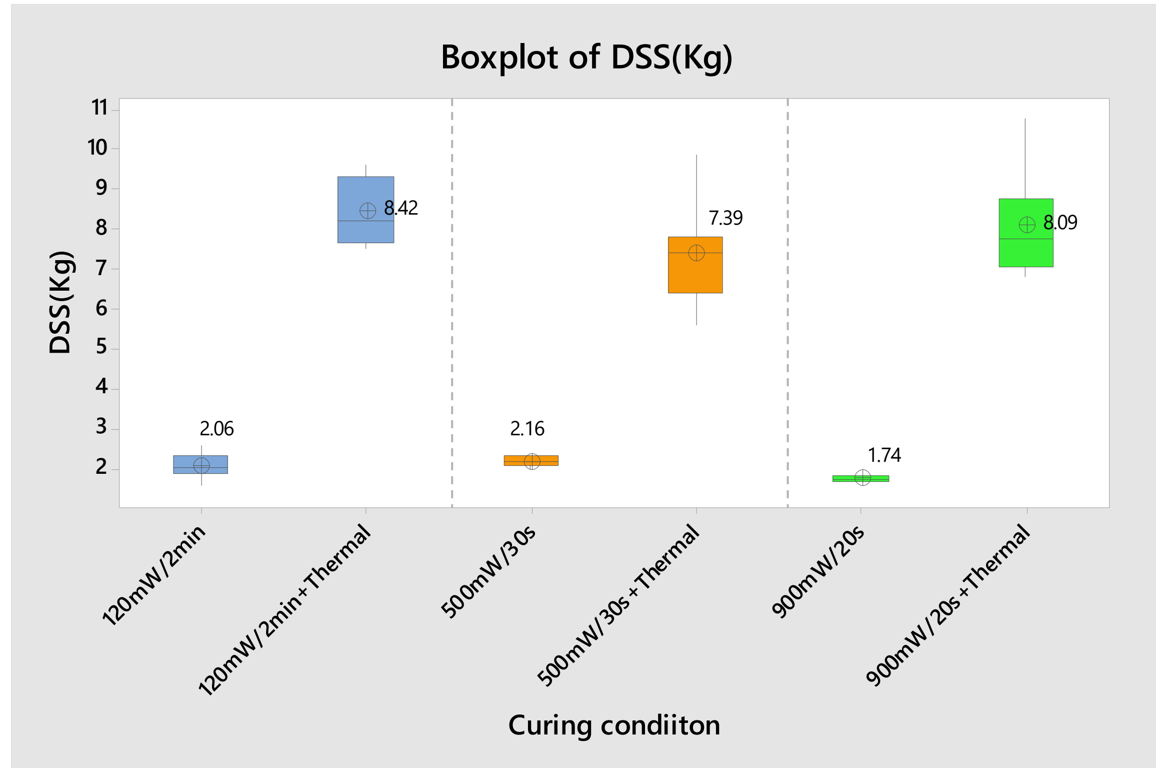
- OS 5101 cures very quickly at 120℃. Only 10min can cure well. But to reach better and stable adhesion performance, longer curing time is suggested (like 30min).



# 3. CURE PROFILE STUDY

## UV CURING INFLUENCE ON ADHESION

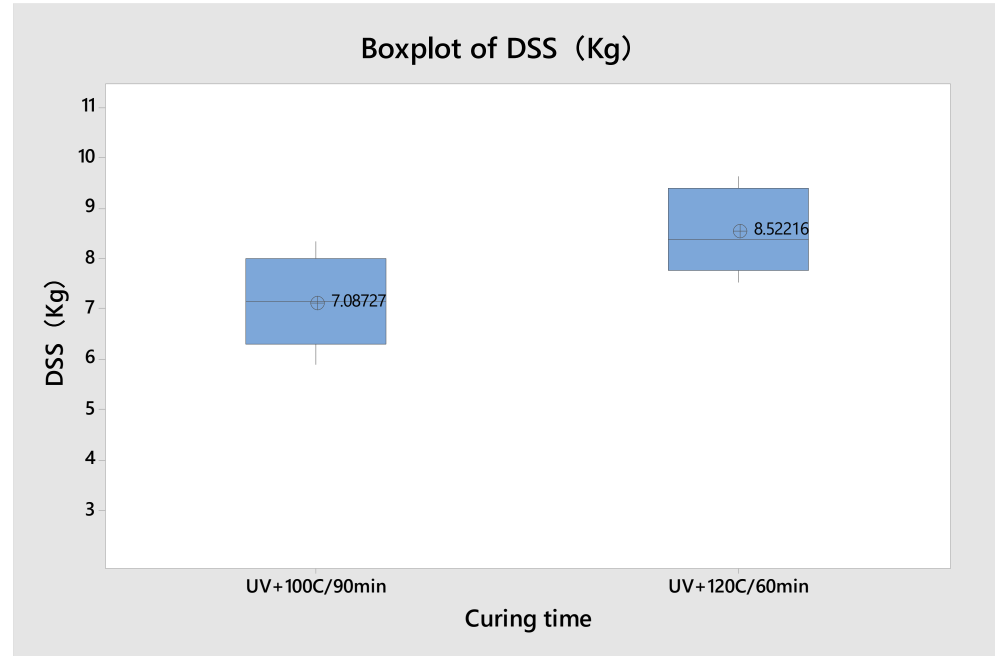
- Substrate: 2*2mm glass die/glass
- UV cure condition:
  - 120mW/2min
  - 500mW/30s
  - 900mW/20s
- Thermal curing condition: 120℃/60min.
- All the glass dies can fix to substrate well after three UV curing conditions.



# 3. CURE PROFILE STUDY

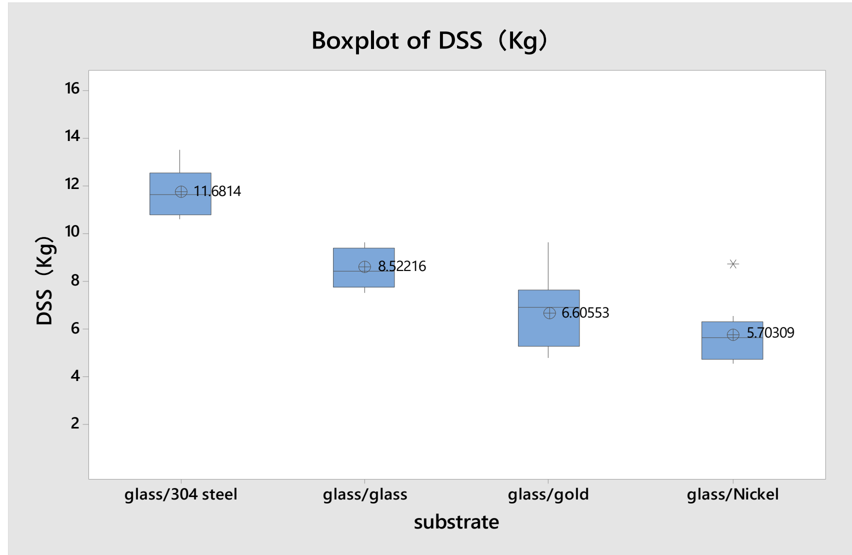
## THERMAL CURING INFLUENCE ON ADHESION

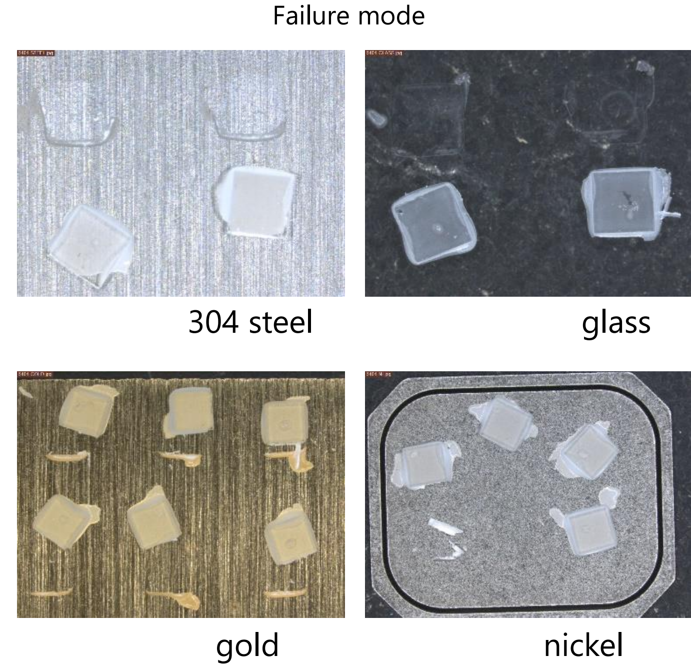
- Substrate: 2*2mm glass die/glass.
- UV curing condition: 120mW/2min.
- Higher thermal curing temperature can reach higher adhesion.



# 4. ADHESION PERFORMANCE

## ADHESION ON DIFFERENT SUBSTRATES




- Substrate: 2*2mm glass die, 304 steel, glass slide, gold, Nickel.
- Curing condition: 120mW/2min+120℃/1h.
- Failure mode on four kinds of substrates is similar. The failure mode is at the adhesive/substrate interface.
- Adhesion of OS 5101 is influenced by substrates. Nickel has the lowest adhesion. Steel has highest adhesion.

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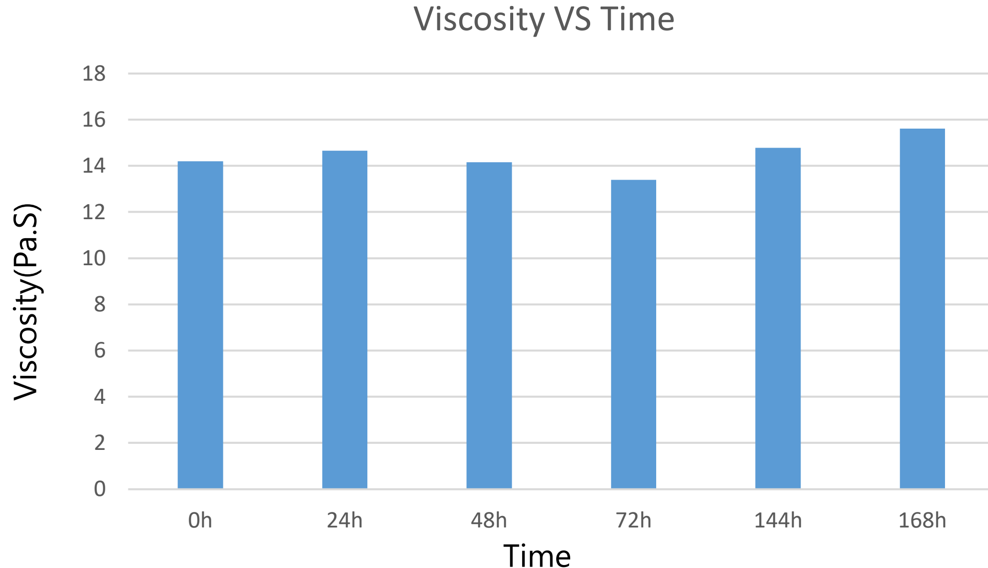
# 5. WORK LIFE

## VISCOSITY

- Store condition： RT
- Test condition: TA2000 Viscometer, 20mm spindle, 200um gap, 20rpm@25℃
- Viscosity increased less than 10% even after 168hrs (stable for 168hrs)

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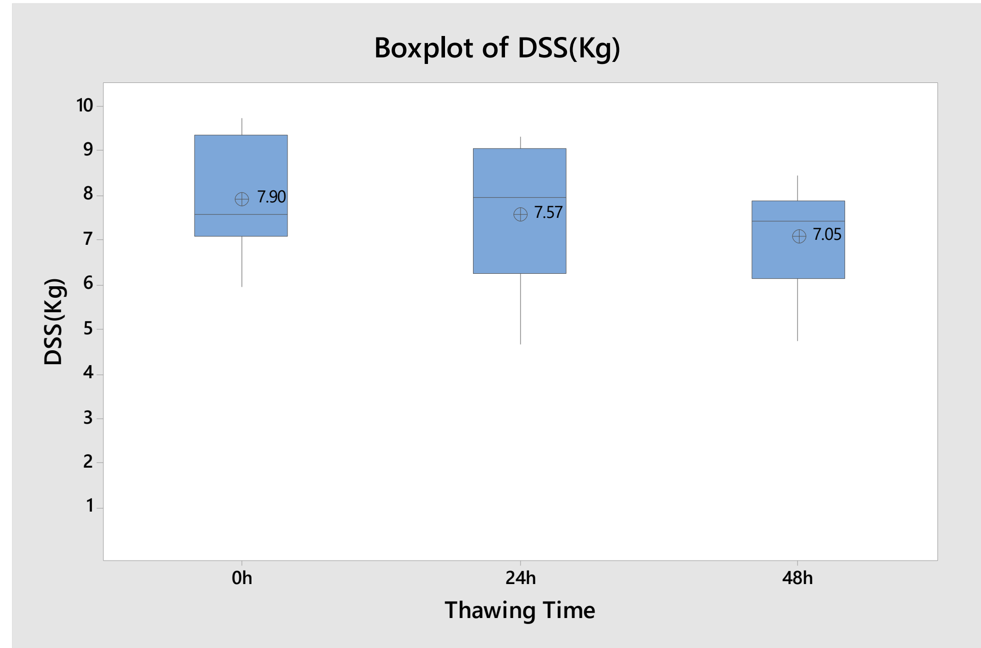
# 5. WORK LIFE

## ADHESION

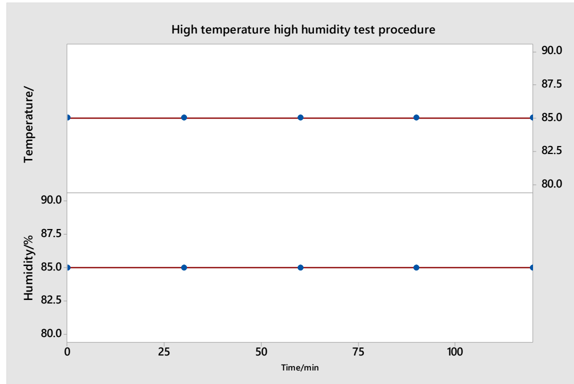
- Substrate: 2*2mm glass die/glass.
- Curing condition: 120mW/2min+120℃/1hr.
- Average adhesion of OS 5101 all higher than 7kg within 48h.
- OS 5101 is an epoxy cation system. To guarantee the stable curing and adhesion performance, we recommend taking 24h as work life of OS 5101.

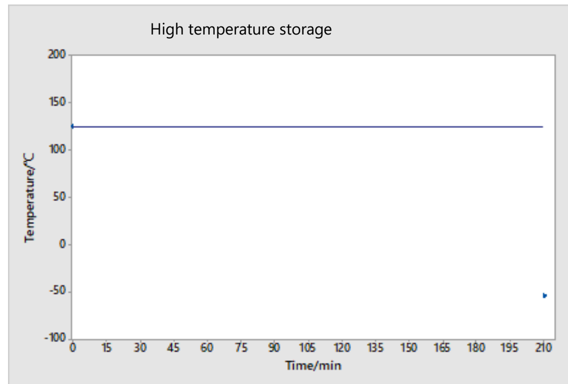


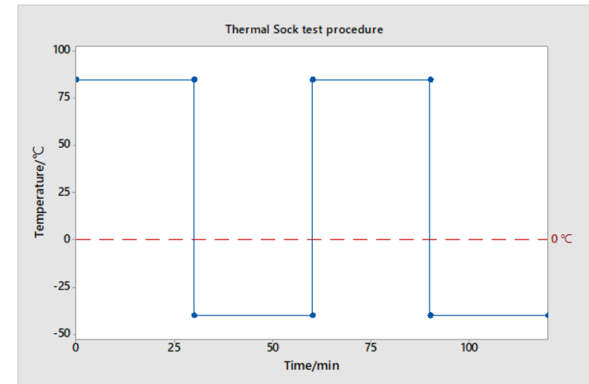
# 6. RELIABILITY

## AGING TEST PROCEDURE

| Item | Humidity Test | High Temp Storage | Thermal Shock |
|---|---|---|---|
| Substrate | 2*2mm glass/glass substrate | | |
| Curing condition | UV+120℃/1h | | |
| Procedure | 85℃/85%RH | 120℃ | -40~85℃ |
| Time/cycle | 0, 500, 1000, 2000 hours | 0, 500, 1000, 2000 hours | 0, 500, 1000, 2000 cycles, 1h/cycle |

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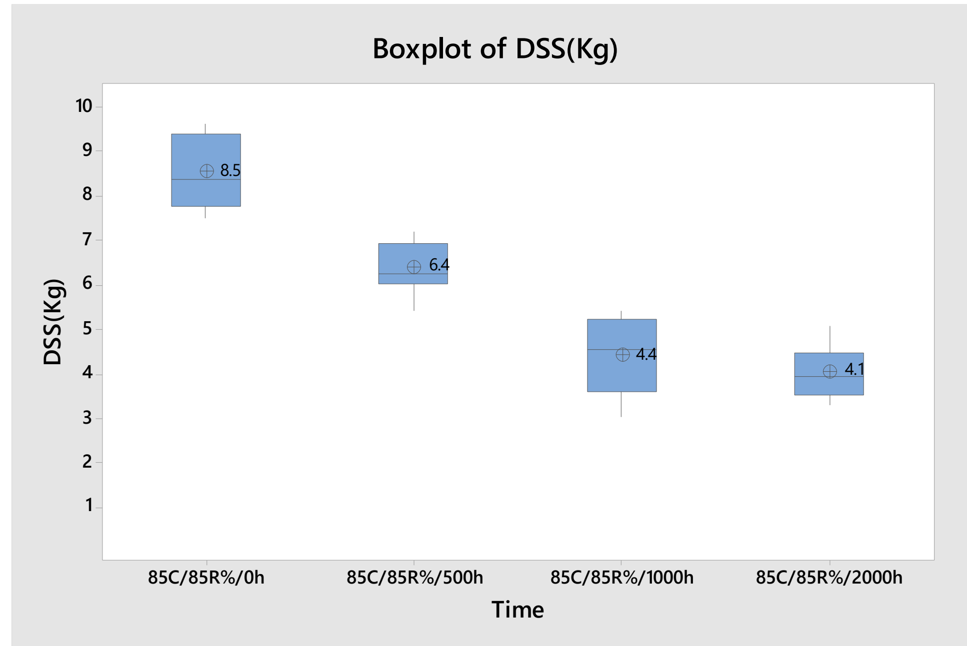
# 6. RELIABILITY

## HUMIDITY TEST




- Adhesion decrease 50% after 2000hr/85℃/85RH%, so humidity has impact on adhesion. Adhesion decrease rate tends to slow down after 1000hr.

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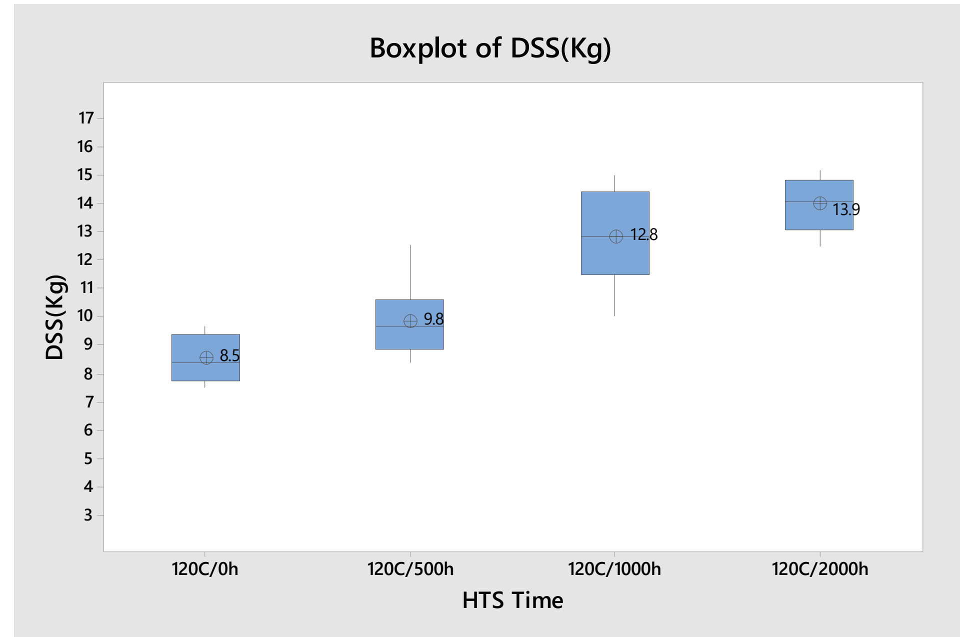
# 6. RELIABILITY

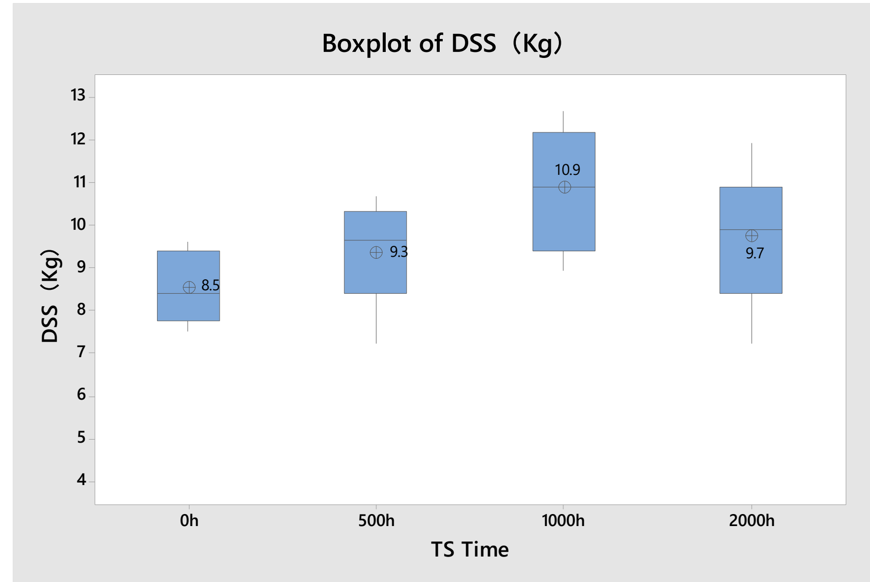
## HIGH TEMP STORAGE




- Adhesion increase more than 50% after 2000hr high temperature storage.
- This adhesion increase due to post curing during baking.

# 6. RELIABILITY

## THERMAL SHOCK




- For thermal shock test, almost no adhesion reduction happened after 2000hr which means temperature below Tg have little effect on bonding strength for glass substrate.

Note: Thermal Sshock performance will also be influenced by the substrate and structure design.

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# 7. APPLICATION NOTE

- Thaw to room temperature before using. Thawing time is 1 hour for 3cc package.
- DO NOT re-freeze once thaw to 25℃.
- OS 5101 is UV sensitive. Exposure to daylight or UV light should be kept to a minimum during storage and handling.
- OS 5101 can cure under both UV+ thermal or pure thermal condition, but 'UV only' curing is not recommended.
- To reach higher adhesion, higher thermal curing temperature (≥120℃) is recommended.
- UV power density will affect curing speed. Higher UV density can reach higher curing speed. But this will lead to higher curing stress which maybe negative depending on application.
- To better manage curing shrinkage and stress, we highly recommend using lower UV power density and shorter time to cure this adhesive. For UV curing condition, please refer to the TDS guideline.

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