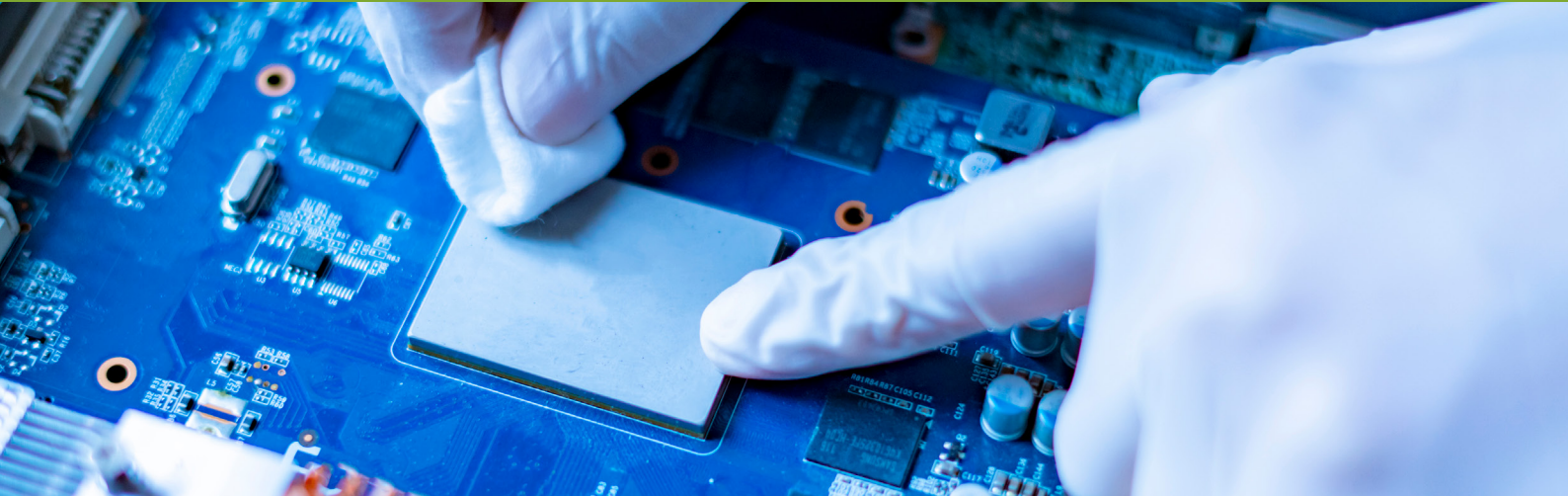


Die Pull Testing - Improving Test Speeds with UV Adhesives

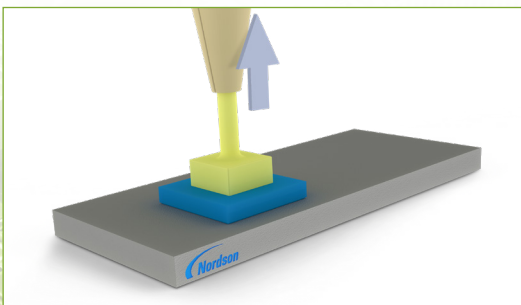
Application Note



Introduction

Stud-pull is a popular method for testing the bond strength of dies and other components that have a large area to thickness ratio. The most common way of attaching the stud to the top of the component to be pulled is to use superglue (cyanoacrylate); a moisture curing glue that can bond to most surfaces. Nordson DAGE has had a lot of success with using Loctite 480, which is a rubber particle toughened version.

The main issue with using superglue is that it takes several hours to cure to full strength, because moisture is required in the curing process and if moisture cannot pass through the components being bonded (such as an aluminum stud and a silicon die), then the moisture can only enter through the edges of the bonded surface.



New UV Adhesive

Another class of products are the UV curing glues. These cure rapidly when exposed to ultra violet light and overcome the issue with moisture ingress.

Loctite AA 358 UV curing adhesive was used to bond nylon M2 bolts, with a head diameter of 3.7 mm, to a square silicon die surface. In order to use UV curing glue, the stud must be transparent to UV light, so the usual aluminum stud was replaced by nylon (Figure 1). The bolts were placed on top of the dies, with a small spot of adhesive, but no pressure was used during curing. A 4 Watt UV (type 3) curing lamp was used for 6 minutes to cure the adhesive, prior to stud-pull testing.

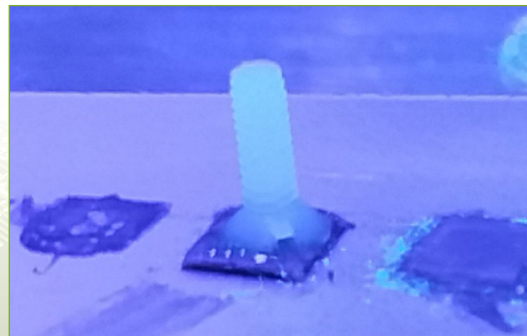


Figure 1 Nylon stud being bonded to a silicon die curing under a UV lamp

As a direct comparison, Loctite 480 superglue was used to bond steel M2 bolts to a second set of identical silicon dies, with a curing time of 3 hours. All the bolt heads and the die surfaces were abraded using emery paper (silicon carbide) before bonding to provide the maximum strength.

The bond strength was tested using a 4000Plus, fitted with a PP50KGHR cartridge and using Paragon™ Materials software control. The silicon die samples were bonded to a block of aluminum that was clamped in a standard work holder vice. The stud was pulled using an M2 threaded female stud pulling fixture. A typical force vs. axis displacement result is shown in Figure 2.

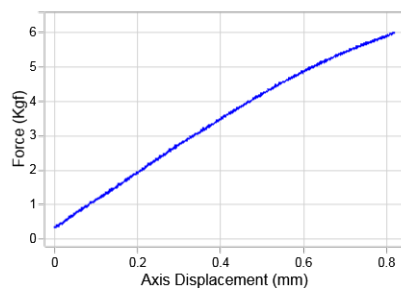


Figure 2 Pull test results of UV Glue/ Nylon studs

In addition to the advantage of the significantly reduced cure time, nylon countersink bolts could be a very cost-effective stud for small dies, instead of the previous machined aluminum studs. If the maximum pull force was required, then the nylon could be machined or molded to match the die size. High power UV lamps can present safety issues, but in this case a low power cosmetics lamp designed for home use was used, so the additional equipment can be inexpensive and safe to use. Alternatively, Loctite offer the Zeta® 7401 Flood System, which is a purpose built desk top UV curing station, with a 400 Watt bulb that would cure the adhesive even faster.

Glue/steel Stud Pull Load (kg) Conventional adhesive	Glue/nylon Stud Pull Load (kg) New, rapid cure adhesive
6.2	4.8
3.6	5.4
6.1	5.1
4.9	6.1
7.3	4.6
Mean: 5.6	Mean: 5.2
Time to cure 3 hours	Time to cure 6 minutes

Results

Five samples of UV glue/ Nylon and five samples of super glue/ steel were tested, see table. The mean load to failure of the UV glue was 5.2 kg force, while the standard superglue failed at 5.6 kg force. Both glues failed at the interface between the adhesive layer and the bolt head, so they both stick well to the silicon surface and the nylon bolt threads are strong enough to carry the load of a 5 kg pull test. While the mean force was slightly less than the superglue, the cure time was greatly improved.

Key Outcomes

- UV adhesives can be used in place of conventional superglue for silicon die stud-pull
- The cure time can be reduced from hours for superglue, to minutes for UV glue
- Loctite AA358 was successfully used
- The stud must be transparent to UV light, such as unfilled nylon
- The bond strength was only slightly less than the superglue

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