Application Note

Smart Passivation Shear – The Most Reliable Way of Testing

Introduction

In semiconductor, passivation refers to leaving a material chemically inert through a formation of oxide layer on the surface. This allows the device to remain unaffected in its properties when exposed to environmental elements.

Passivation layers range in thickness from nanometres to tens of microns and testing of interconnects situated within the passivation layer pose a unique challenge. Testing may also lead to inconsistent results that can be difficult to interpret. To avoid complications, it's important to use the right tools to remove any adverse effects the coating may have on the test result. In this application note we introduce DAGE's solution SMART passivation shear to improve the consistency of results when passivation layers are present.

Shearing at The Correct Height

Testing of interconnects on devices with passivation is difficult due to the protective coating interference. These coating layers are well-adhered to the surface and bonds can be entrenched up to 10µm within the cavity. Typical test standards recommend the shear height to be 10% of a given bond height to apply maximum load to the bonded interface and the tool must also be given enough space to accelerate up to the correct test speed. Due to this, testing with a regular chisel-like shear tool is not possible as standard shear tools are unable to cut through passivation layers to shear the bond at its base, see Figure 1.

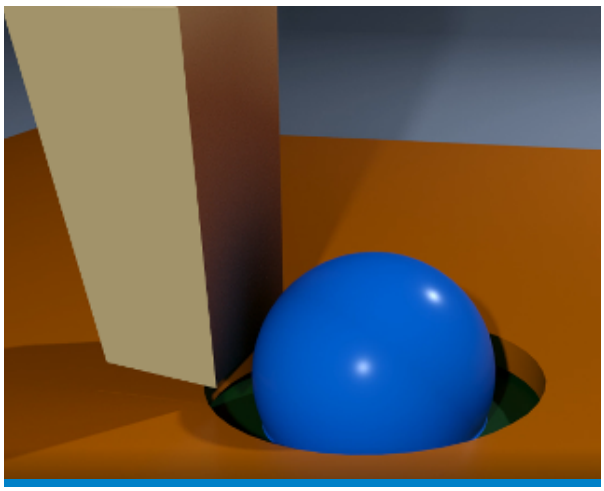

Figure 1. *A regular shear tool used in a passivation shear test; ball bond is sheared at surface*

To overcome this challenge, a sharp and tapered passivation tool must be used to cut downward into the passivation at a pre-determined depth. This allows for an accurate measurement of the true bond strength by performing the test at the correct shear height, see Figure 2.

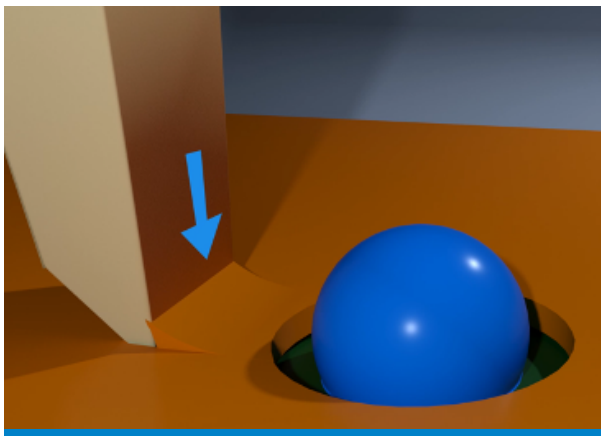

Figure 2. *Passivation tool cutting through the passivation layer prior to a test*

The Challenge with Passivation Results

Even with the correct shear tool, force readings from the test may still be difficult to interpret. The failure force of an interconnect can, in some cases, be relatively small compared to the shear force of the strongly adhered passivation layer. As such this can lead to an undetectable bond force hidden within the passivation profile.

Force profiles collected from passivation shear show multiple peak loads. Debris trapped underneath the tool can lead to increased frictional forces. As a result, it's not uncommon to see a fluctuation in passivation results making it difficult to differentiate from the interconnect failure force. While it's possible to interpret the data correctly, it relies experienced operators and consistent samples.

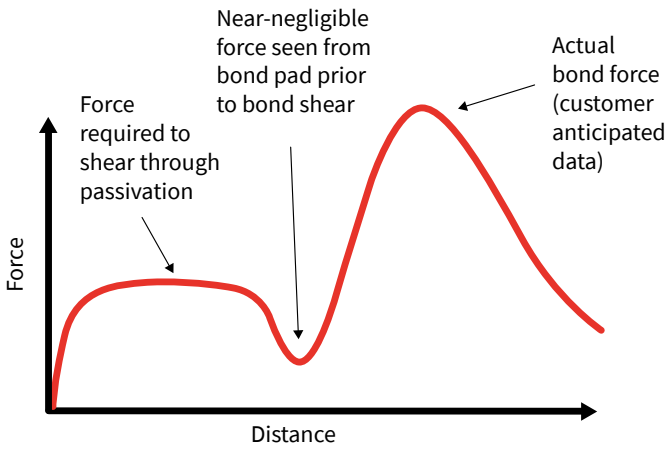

Figure 3. *Typical passivation shear force profile showing both passivation and bond forces*

An additional challenge arises when aligning overlaying force profiles to look for trends with the process or material changes. Traditional passivation shear can mask the true bond force and introduce errors because of operator tool positioning. The offset seen arises because the distance behind the interconnect is variable. This happens due to parallax error when the operator positions the shear tool using the stereomicroscopes.

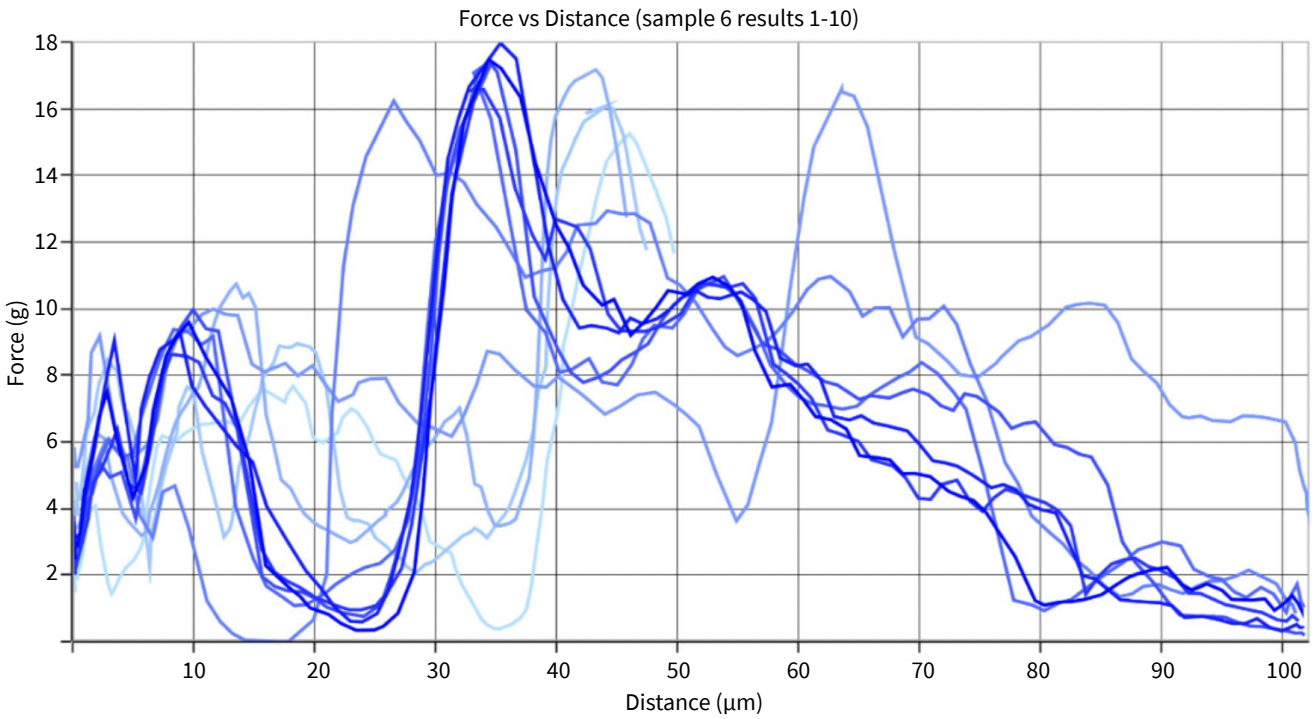

Figure 4. *Typical passivation shear force profile with scattered peaks*

Introducing SMART Passivation Shear Solution

DAGE's SMART passivation shear sequence reduces the analysis time making the test procedure simpler & faster. It also removes operator errors and false calls whilst preserving data integrity.

Using SMART shear, operators are given the flexibility to position the tool anywhere behind the bond. The "bump finder" feature allows bonds in any position or orientation to be tested with the use of our rotary shear cartridges.

How does SMART shear work?

The sharp passivation tool detects the land height using DAGE patented technology and advances forward until bond is located and position is stored. The tool will then move backwards by a defined offset and perform a typical passivation shear test through the material. Paragon™ software removes the passivation force data from the result to prioritise the data collection from the interconnect, showing the operator the data required for analysis only. An example of this can be seen in Figure 5.

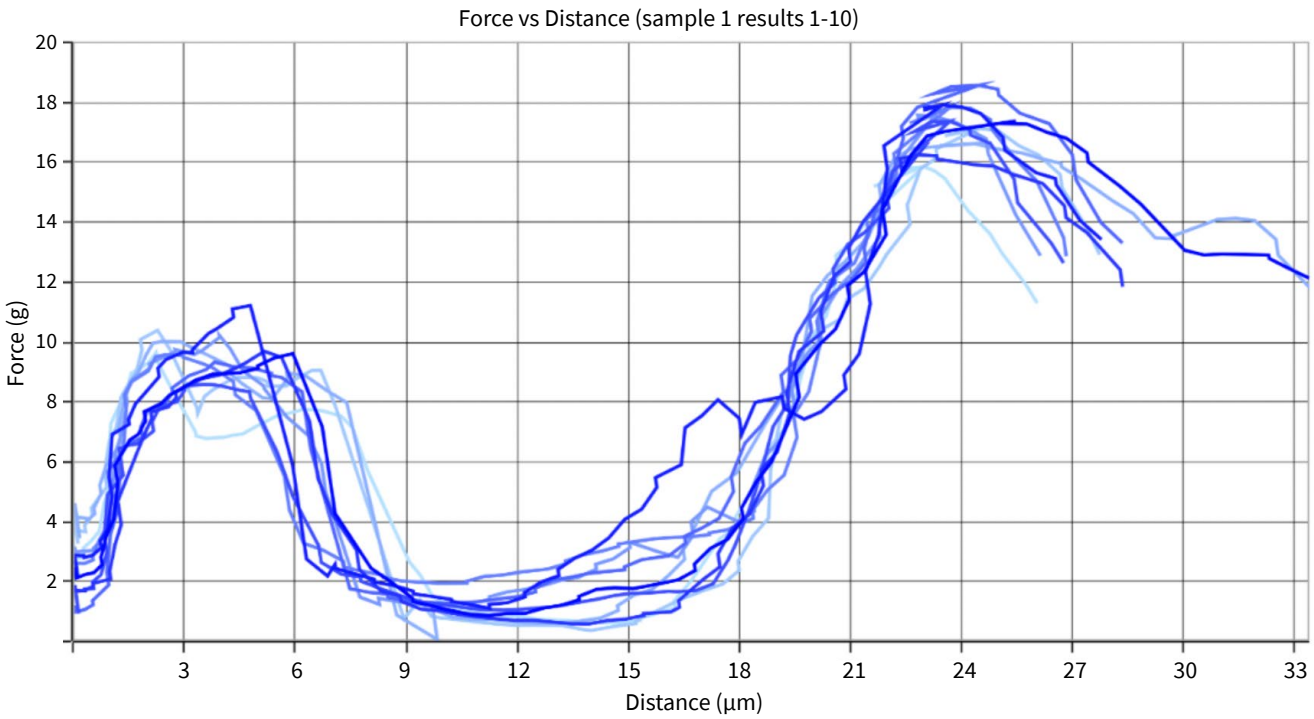

Figure 5. *SMART parameters applied in all passivation shear tests to achieve aligned force profiles for easy analysis*

Conclusion

Repeatable and accurate shear heights are of utmost importance in any shear test. To achieve this on a passivated substrate, the tool must shear through the passivation layer. All challenges that arise from getting the correct data out of this test can be eradicated with the SMART passivation shear function. SMART passivation utilises innovative bump-find technology to record and align the force of the tool shearing through bumps – giving reliable results to ensure process issues can be highlighted faster and more effectively without human error in an otherwise very complex test procedure.