Plating and Film Adhesion Testing Technique

ABSTRACT: The bond quality of plating and films is essential for product reliability but not so easily measured. Conventional scratch testing is a proven method but both complicated and slow making real time process data difficult or impossible. A solution to these issues together with other improvements is introduced.

Fig 1 Wafer with known good and bad film adhesion

Recent developments using a modern bond tester have reduced testing time from days to a few minutes together with the ability to consistently test small selected areas either manually or fully automatically.

Fig 2 XYZTEC Modern Bond Tester

“Small selected areas” would include things like bond pads on an MCM or lab on a chip chemical sensing structures. Using its fiducial alignment a modern bond tester can accurately apply the scratch tip with micron precision anywhere on the sample.

All established scratch test methods are possible including,

> *Progressive Load Scratch Test (PLST)* where the normal or vertical load of the scratch tip increases along the length of scratch. The normal load would typically start so as not to cause any film delamination and build up to the point where the failure mode of interest is achieved.
>
> *Constant Load Scratch Test (CLST)* where the normal load is constant. Several CLST test may be done each with a different normal load, thereby investigating the point of failure.
>
> *Multi Pass Scratch Test (MPST)* that repeats a programmable number of CLST test. This is often done with 50% of the load that produces the failure mode of interest, thereby determining a measure of wear resistance.

The scratch test method has a number parameters including, distance, speed, load or load rate, tip shape and size. These are optimised depending on the sample type and failure mode of interest. To cope with this wide test range the scratch tester must have a correspondingly wide range of test loads, speeds, forces and tooling options. An advantage of a modern bond tester is that it will easily cover the widest range of test settings but also be much easier to setup and use.

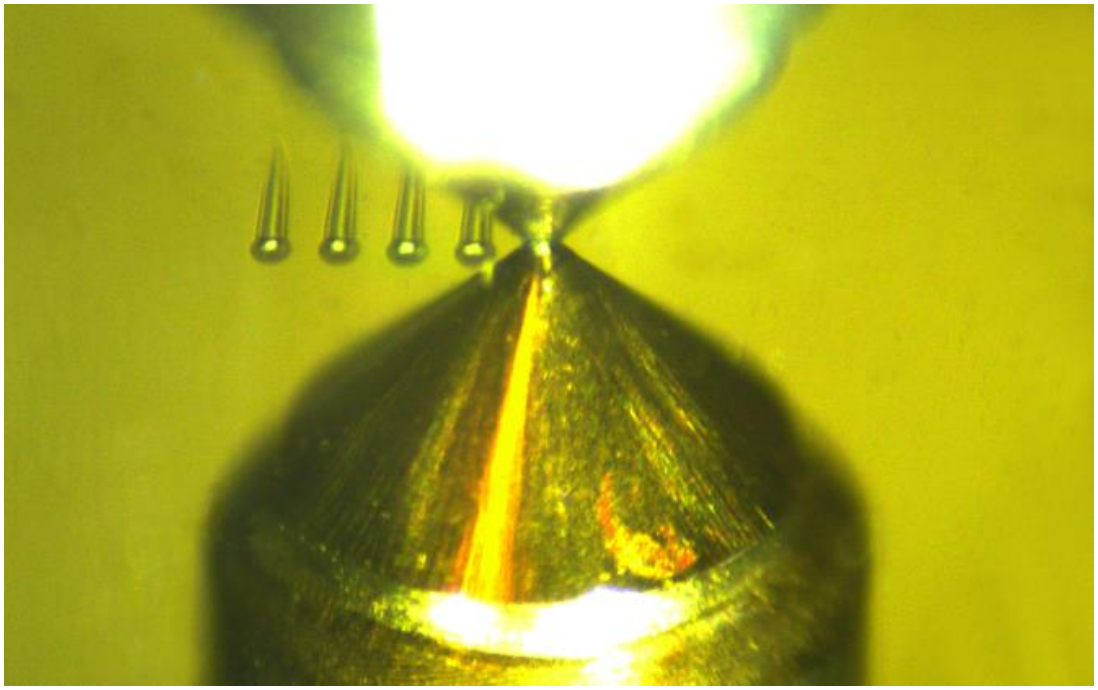

Fig 3 20µm Spherical diamond scratch tip fitted to a bond tester

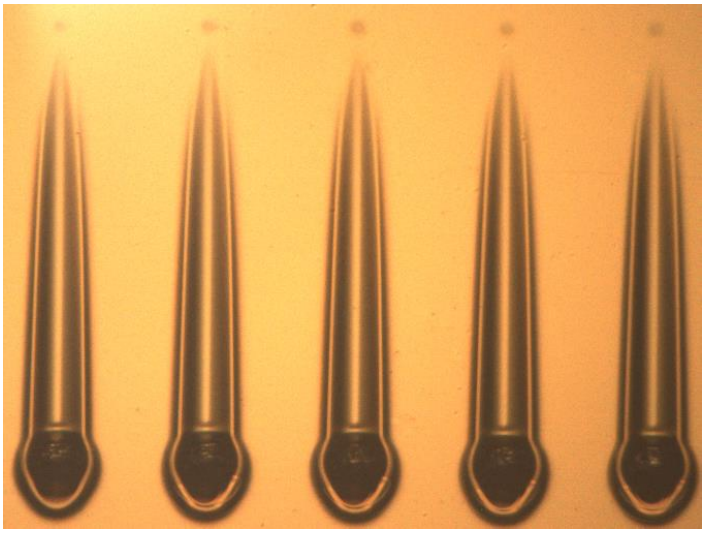

Fig 4 PLST with no delamination

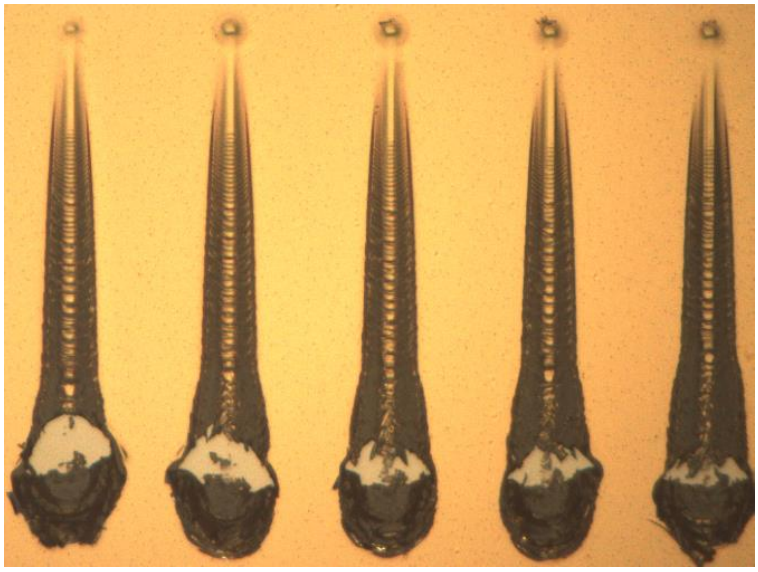

Fig 5 PLST with delamination

Fig 3 shows a bond tester scratch test. In figs 4 and 5 the test method was set such that no delamination and delamination occurred respectively. In fig 5 two stages of delamination are seen, an initial widening of the scratch followed by complete delamination down to the substrate. These tests are typical of an initial investigation to find the “critical” point of failure, where the failure mode of interest is produced.

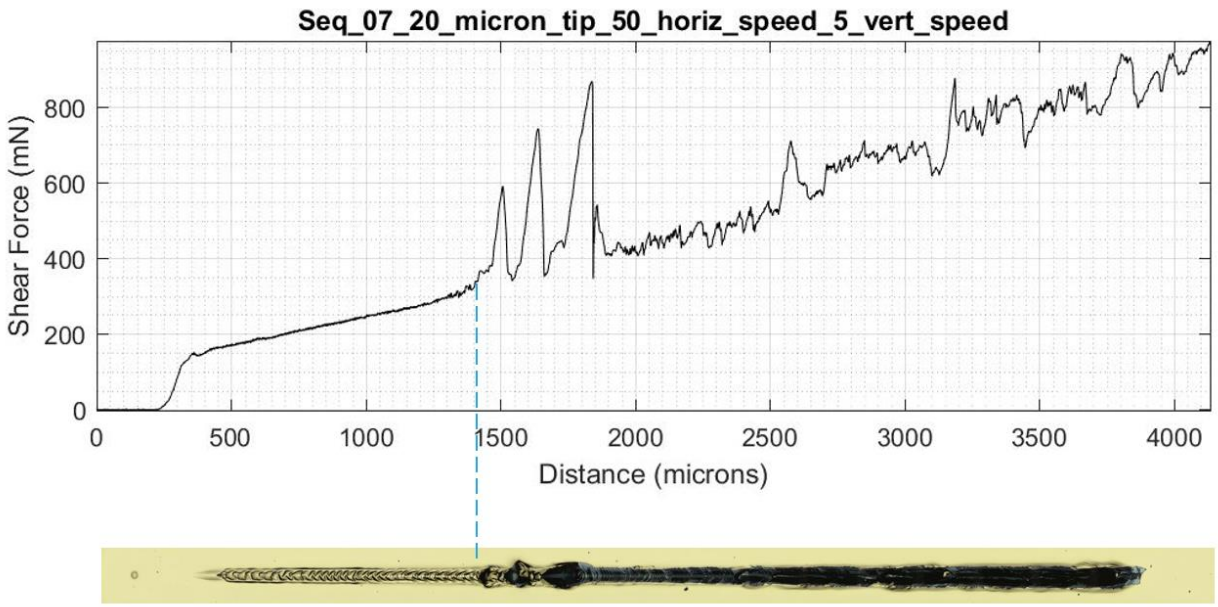

Fig 6 Scratch test with shear force

Having found the critical settings and as shown in fig 6, a PLST can be designed to produce failure close to the centre of the scratch distance. As a process tool the point and force at failure can be used to monitor film adhesion. Similarly CLST test can be adopted or MPST tests for wear resistance.

The tests discussed so far are typical of relatively hard films. A further advantage of a bond tester is that it can perform much more than conventional scratch tests. Softer films like Mylar on glass may be better tested with a knife or tweezer peel.

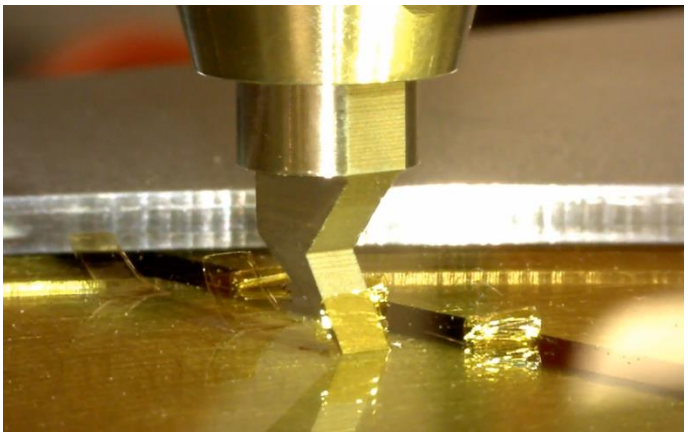

Fig 7 Knife peel test

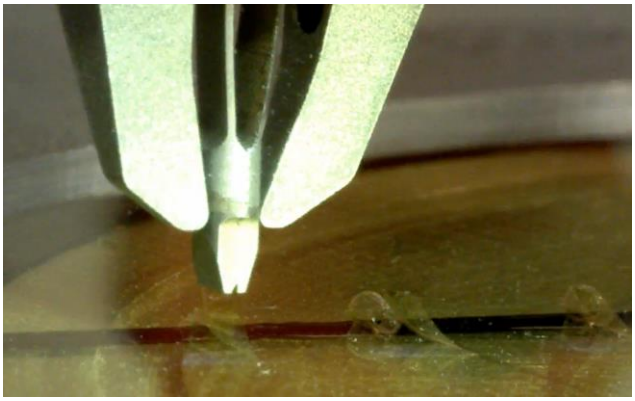

Fig 8 Tweezer peel test

In some tweezer peel tests combination jaws with a knife portion are used to initially lift the film before gripping and then peeling it.

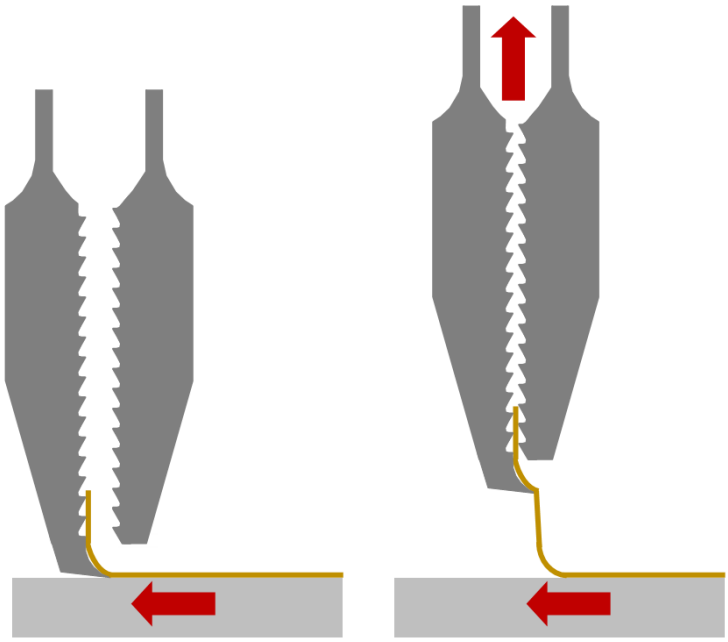

Fig 9 Knife and tweezer peel

A modern bond tester is an extremely versatile micro materials tester that we have only just scratched the surface of!

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