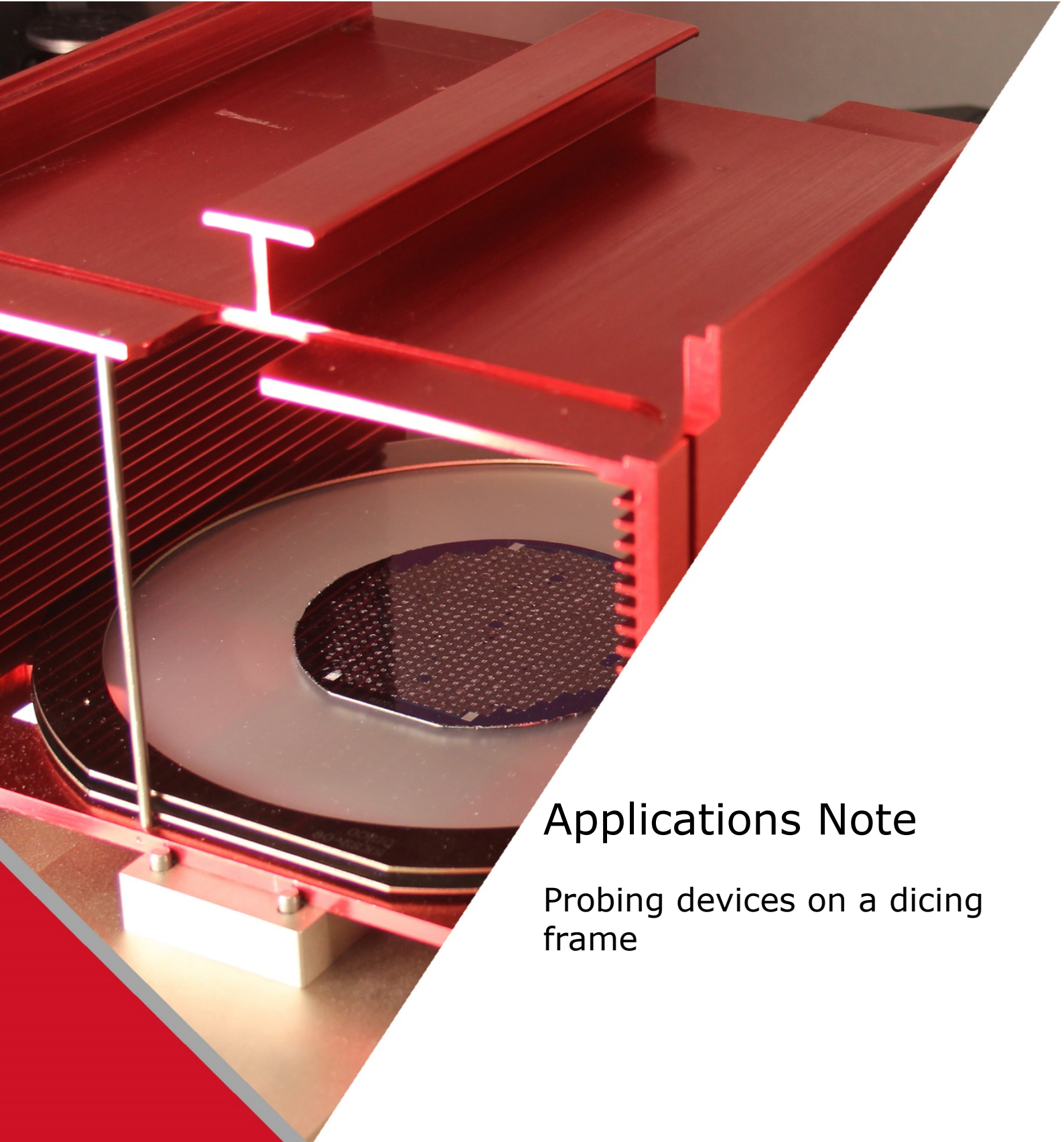


Applications Note

Probing devices on a dicing frame

Wentworth Laboratories

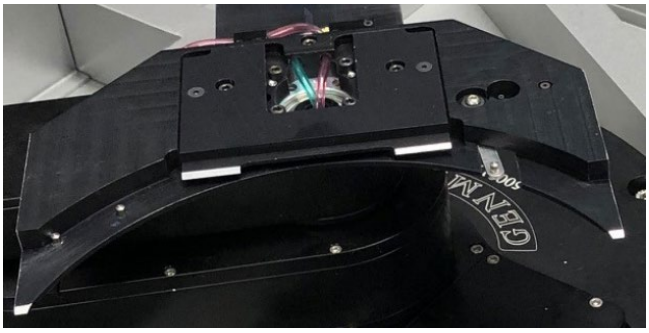
Probing die on wafer frames

There are a number of reasons that you may need to probe a wafer, after it has been diced. In the semiconductor test market, various products such as thin wafers, advanced packages with TSVs, diced wafers, known good die (KGD) application and strip frame devices require frame probing. This creates a range of challenges for conventional probe stations which need to be considered.

Wafer and frame handling

Using wafer handling system to remove traditional wafers from cassettes and load onto a chuck assembly is common practice. The handlers rely on the vacuum pick up from the flat, underside of the wafer. It can then use pre-alignments to detect the flat/notch before positioning on the chuck plate.

When using a dicing frame, these stations are not practical due to the nature of frames and film material. Using the industry standard notch on the frames as a location system, ensures good repeatable position from cassette to the probes' chuck surface. Fortunately, the uniformity of the frame designs ensure we can use the notch to locate these, just as with the more conventional wafer frame processes.



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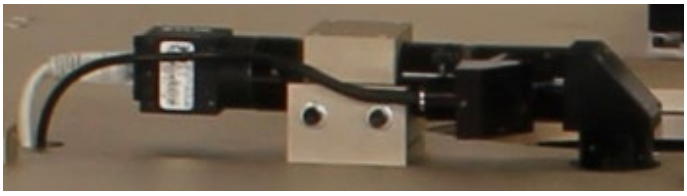
While automated loading and sorting ensures the frames are in the correct orientation within the cassette, additional accuracy is required to position the frames onto the chuck surface and ensure the probe stations pattern recognition systems can locate and align the frame with the accuracy required for probing. Our unique location arrangement on the frame handler arm, means we can rotate and place the frame on the chuck with a great deal of accuracy. This allows the system's pattern recognition solution to align, theta and move to the home die.

Die movement after dicing

Probing die on wafer frames is used in a number of different applications and for different reasons. If you are using the frames for added support – or your die have been placed onto the frames using an industry standard pick & place method – then you can usually move straight to probing from here. However, if your wafer has been diced and then expanded, your die position can not be guaranteed and certainly will not be positioned accurately enough to be able to probe. Remember, the smaller your probe pads, the more criterial this would be.



Wentworth's capability to create an 'on-the-fly' wafer map ensures that no matter how small your probing geometries, we can still put probe to pad.

There are a couple of methods to achieve this but the best route may be determined by either the device or application.

Pre-scanning – best for a large number of die or a relative quick test time:

- Uses the pattern recognition solution to view and create a unique wafer map for each individual frame.
- Ideal if you have missing die on the frame.
- Best for partial wafer probing.
- Creates an accuracy representation of the wafer even for large errors or die movement
- Line-scanning used for quick and accurate scanning.
- Although it creates an extra step, in some circumstances this can still be quicker.

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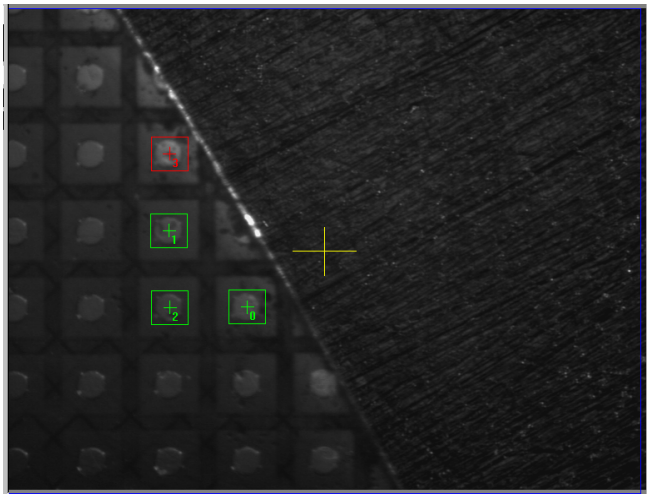
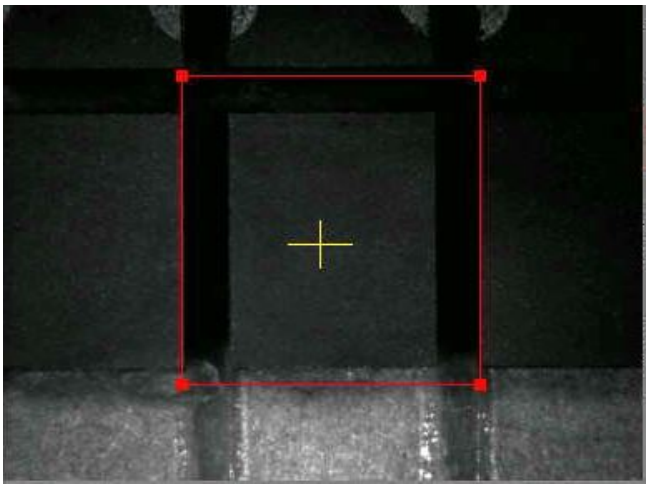


In-line adjustment – larger die or die with longer test times:

- This method uses a predetermined wafer map and captures an image of each die.
- No need for extra scan steps.
- Uses wafer map templates to step to expected die position and then carries out a second movement to adjust in X, Y and theta.
- Ideal for larger die or tighter accuracy on film expansion.
- Increases step time per die.



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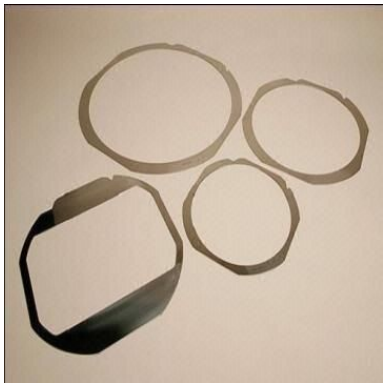
Film properties

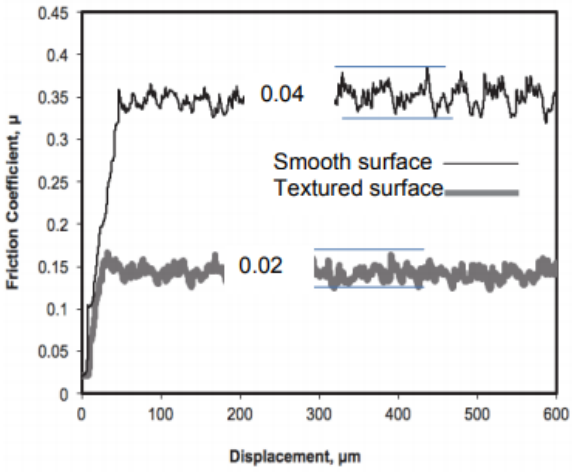
It's also worth noting that both the film and the frames can impact the ability to the system to probe wafers. Most larger frames are now metal but a lot of 4", 6" and 8" frames are still plastic. The cycle of heating and cooling the film can cause the frames to warp over time – we have seen as much as 3mm[1] of warping on frames that have been in use for a while. While not an issue with manual loading, it is best to limit this with handling systems. If you need to keep these frames in circulation, this issue can be catered for on the handling arm but wider pitch cassettes (or alternate slots) may need to be considered.



In addition to the frames, the film also causes some issues as it can frequently 'stick' to the chuck surface and tear as the handler is trying to remove it. Vacuum can leak from the normal chuck layout and cause the film to be adhered to the chuck plate surface. When the vacuum is switched off, pockets of localized vacuum remain, causing the film to stretch or tear when the handler tries to unload and load the next frame.

A number of research projects have been conducted on this issue, as the traditional tendency is to improve the surface finish of the substrate supporting plates (i.e. chuck plates).

At the IOP Conference Series: Materials Science and Engineering in 2017[2], a presentation demonstrated the effects of surface finish on various aspects of stiction as shown in the graph below.



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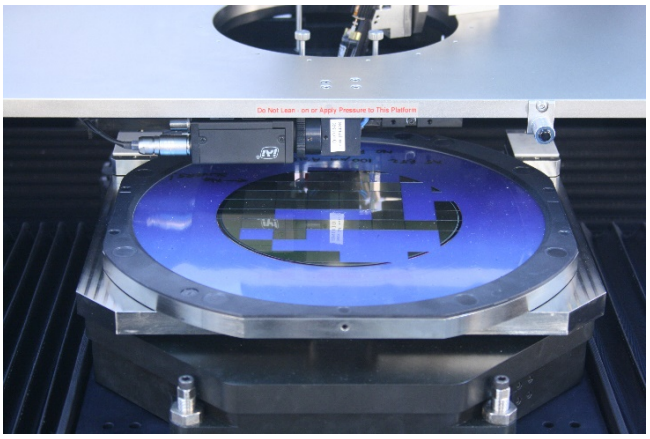
They concluded that the effect of the surface parameter to the stiction propensity has been investigated by using the viscoelastic material. The result can be summarized as follows:

1. The normal contact stiffness of the textured surface is lower than that of the smooth surface. This effect is caused by the reduction of real contact area, due to the presence of the texture.

2. The value of the difference between the static and kinetic coefficient of friction, μs-μk, for the textured surface, is lower than that of the smooth surface. Thus, introducing texture to a contact interface, could reduce the stiction propensity.

The vacuum layout is important to this, as the traditional groove needs to be avoided. However, changes are also required to the chuck material and design, to avoid this stiction.



Wentworth's proprietary wafer-frame chuck design ensures both wafers and wafer frames can be probed on the same system. The frame warping can be overcome, but metal frames perform much better and have longer life.

Dual wafer and frame probing

A growing number of our customers have a wide range of products and require more versatility out of their probe systems. If you need to be able to probe both wafer and frames on a single automated system, then your probe station needs to be capable of locating both wafer cassettes and film frame cassettes.

This requires additional space, particularly if you may wish to load two different types side by side. With the industry standard 'H' cassette mounting, we can fit both types of cassettes and the A200's cassette-sense can tell which cassette has been inserted.

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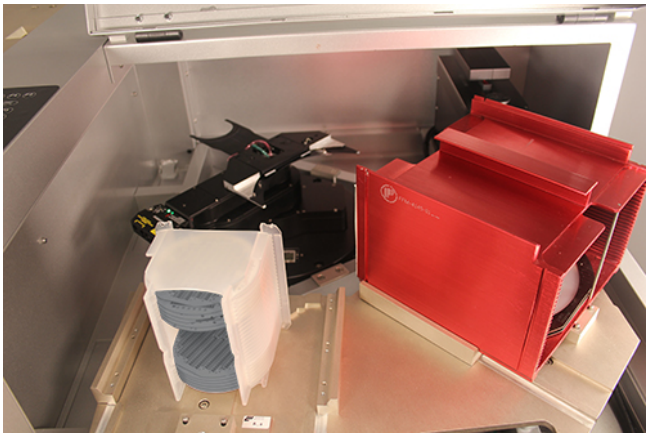
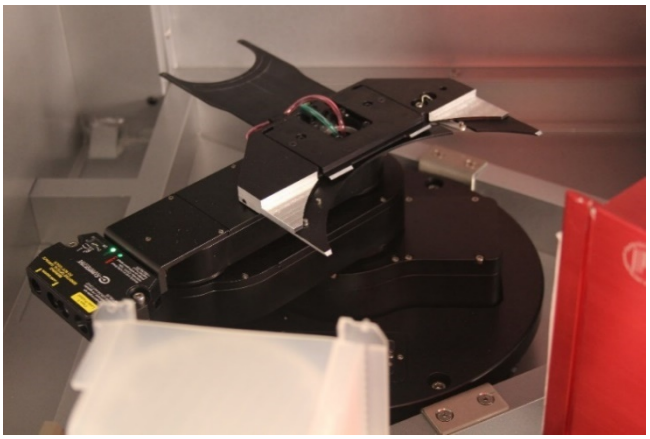


The system will then be able to instruct the handler as to which arm of the dual end effector to use for collection.



1 – Internal measurements of customer supplied frames.
2 - Effect of roughness on stiction - Zahrul Fuadi et al 2018 IOP Conf. Ser.: Mater. Sci. Eng. 352 012009

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