Au-Sn Eutectic chip-bonding for high heat flux vapor chamber applications Using Flip-Chip Bonder

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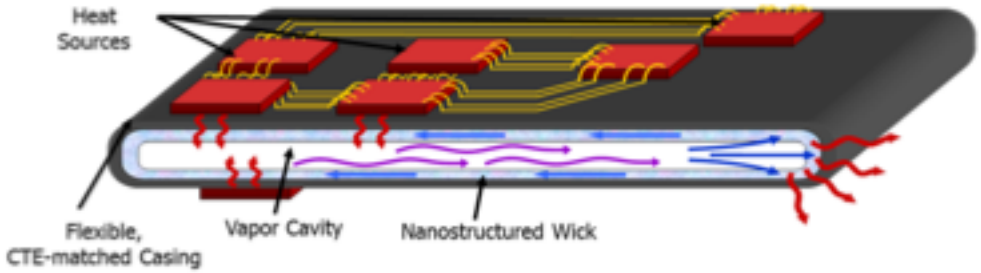


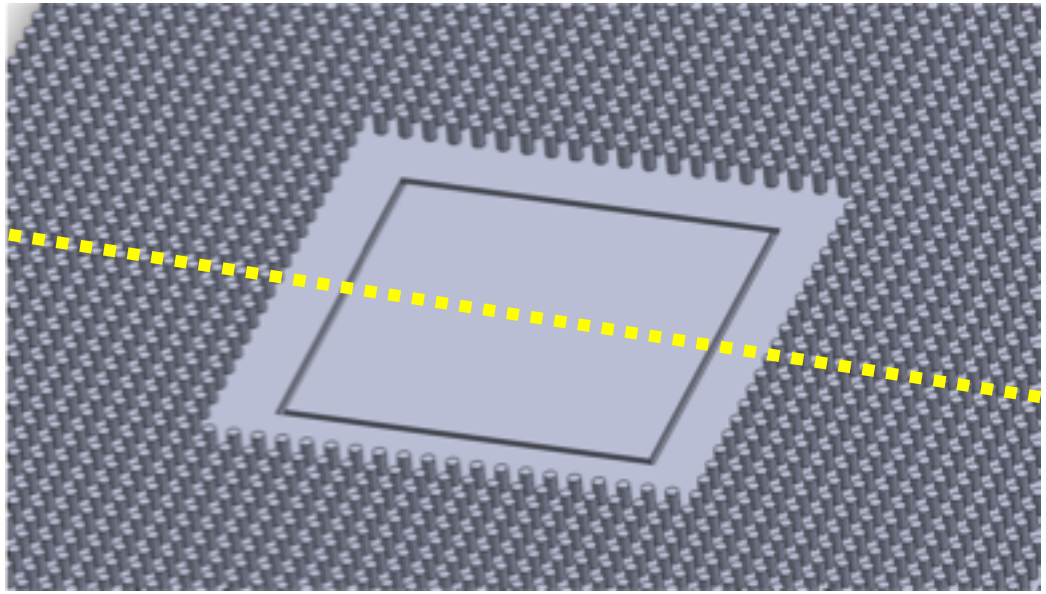
Bar-Cohen et al. (2015)

Suggestions and Tips (Survey)

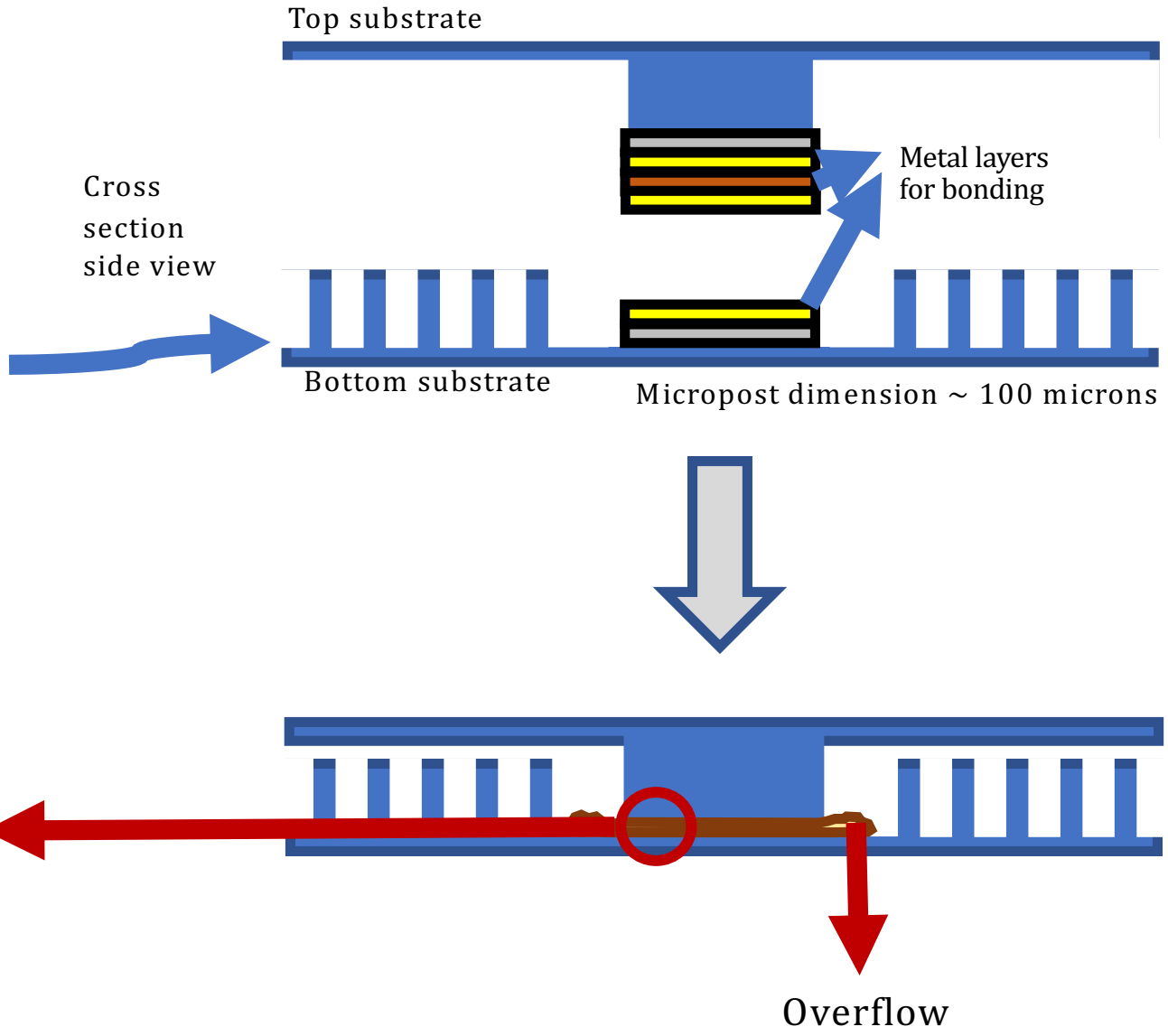
**For detailed information have a look at the Report*

Motivation

Microstructured bottom substrate inside a vapor chamber (3D)



Inside of the proposed vapor chamber design



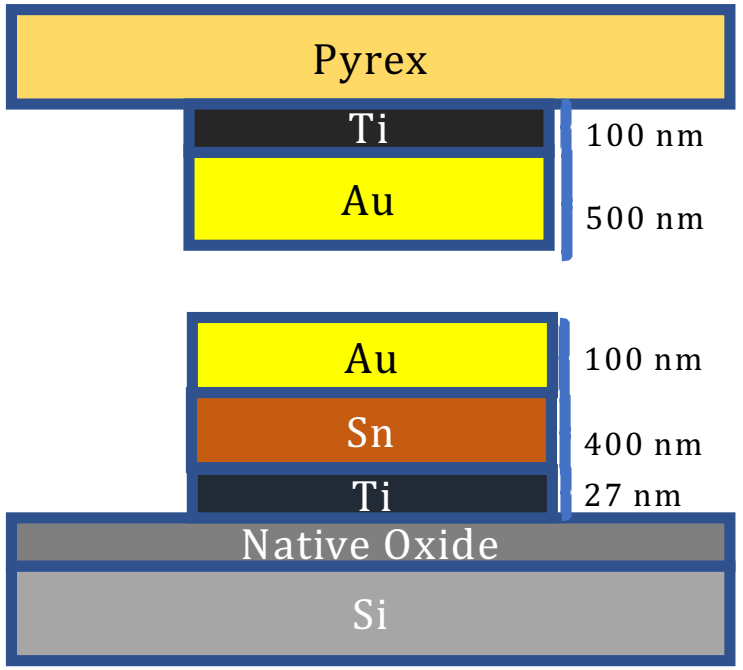
Important parameter –

- Robustness, Strength – Bond Quality and overflow

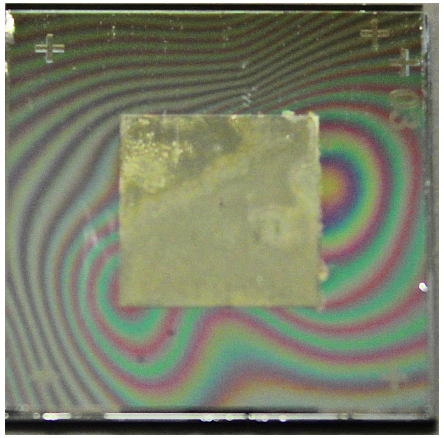
Experimental Process Flow

1. Making Masks (External)
2. Sample fabrication → Faced Issue
3. Metal deposition
4. Bonding → Faced Issue
5. Testing → Faced Issue
6. Analysis of overflow restriction with trenches

Substrates before Bonding



Substrates after Bonding



Sample Fabrication of Pyrex Wafer : Things to Remember

- Deposit metal on the alignment marks and dicing lines, thus getting rid of an extra set of lithography steps-etching.

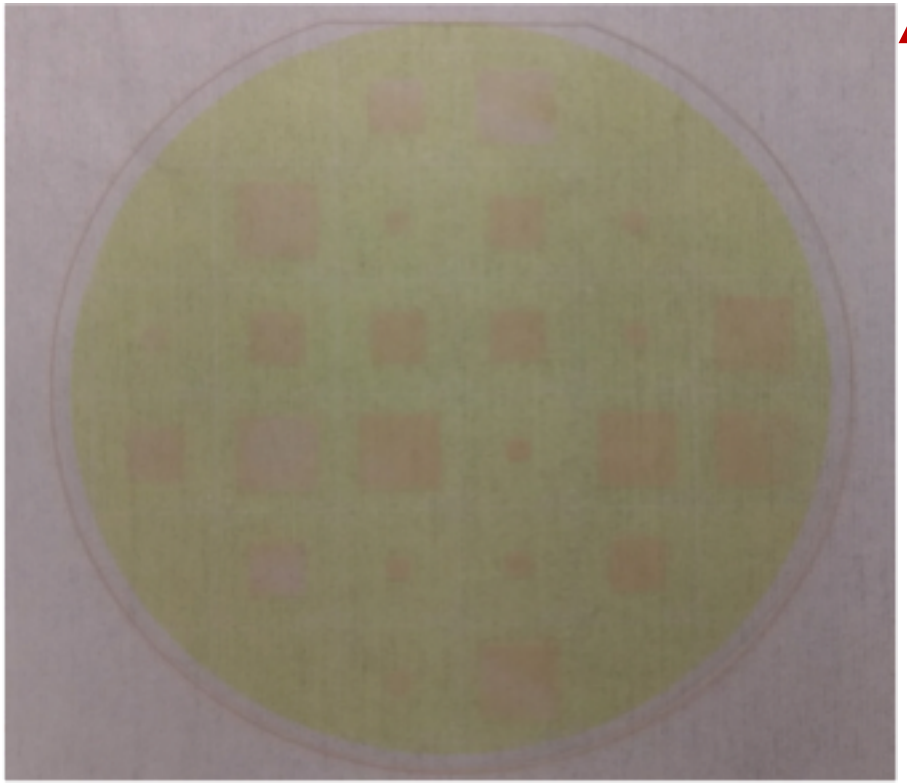
- Do Double Exposure of Pyrex: What is double exposure?
  Expose the Pyrex wafers immediately after the first development stage with the next second mask.

- REMEMBER: This type of multiple exposure is possible only when the developer used, in this case, MF-26A (2%TMAH) doesn't react with the unexposed photoresist

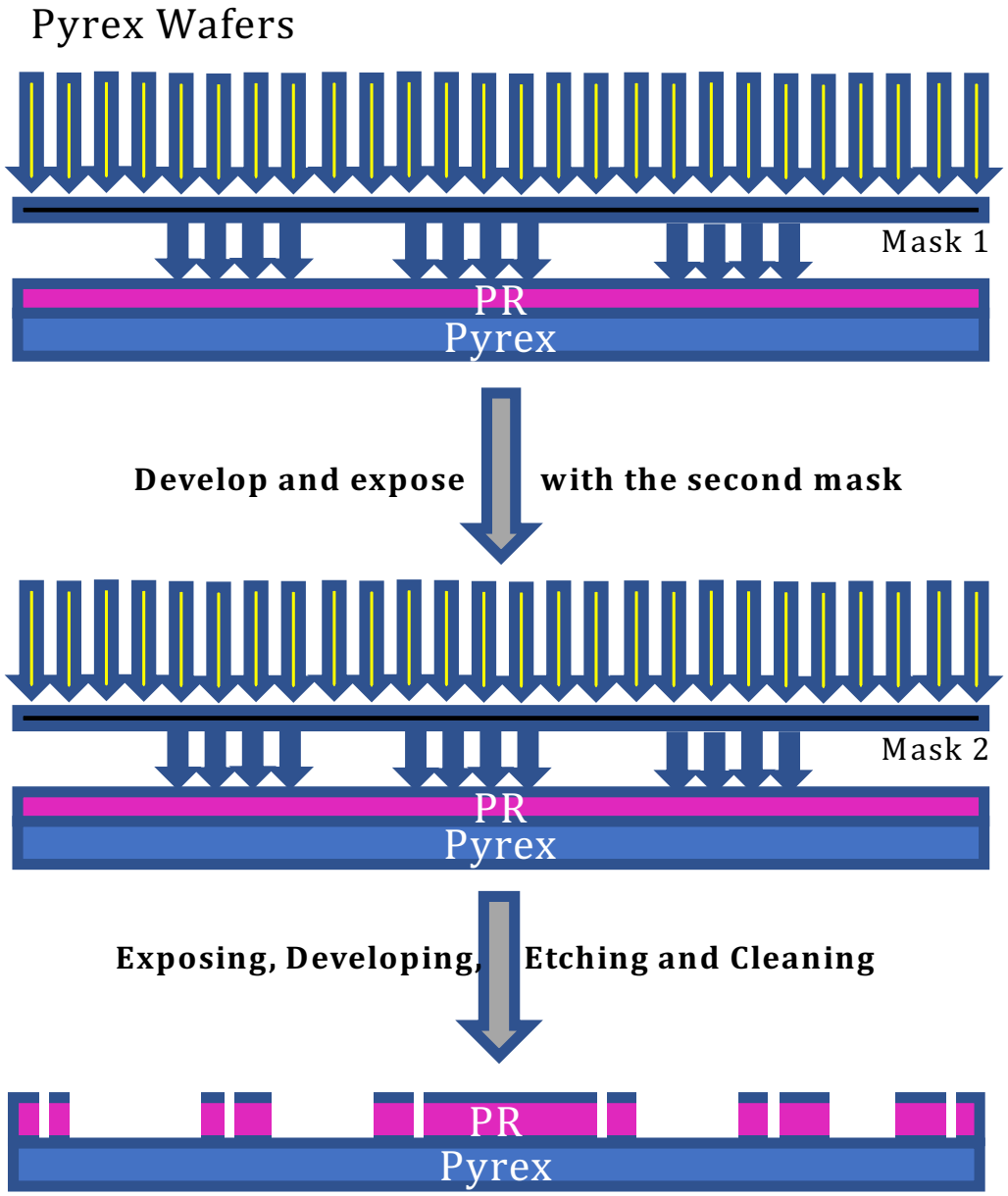
Double Exposure for Pyrex wafer using Karlsuss

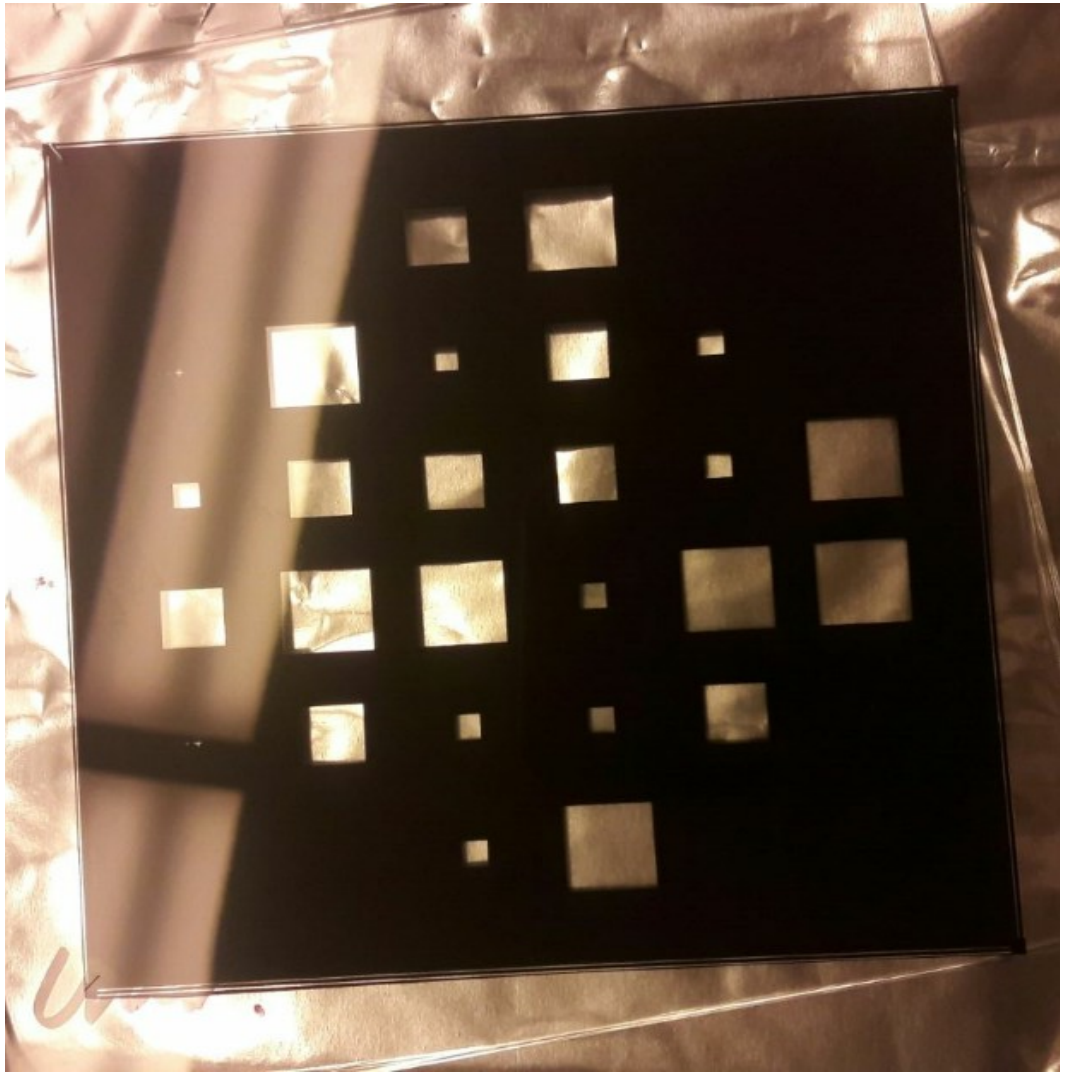
Exposure Duration – 0.8 ~ 1 s (for 1 µm PR)

Exposure Duration – 1.8 ~ 2.4 s (for 1 µm PR)



PR residue as a result of insufficient exposure time (0.9 s) during second exposure



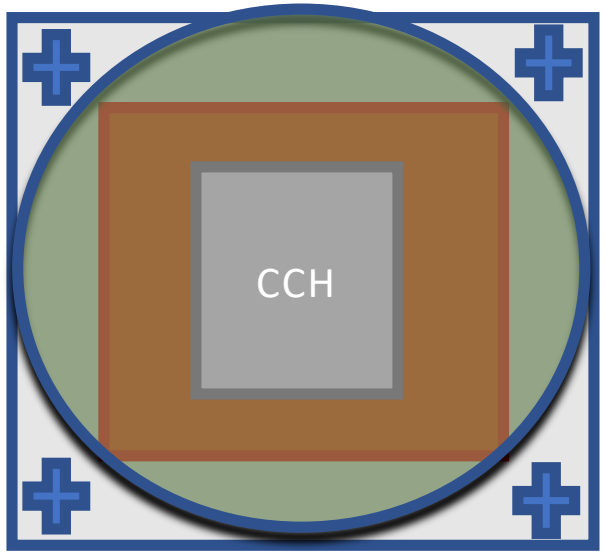


Mask 2

In our project, to ensure that there is no photoresist left on the windows, the second mask was exposed first, and following spray development, the second mask was exposed with a larger UV dose.

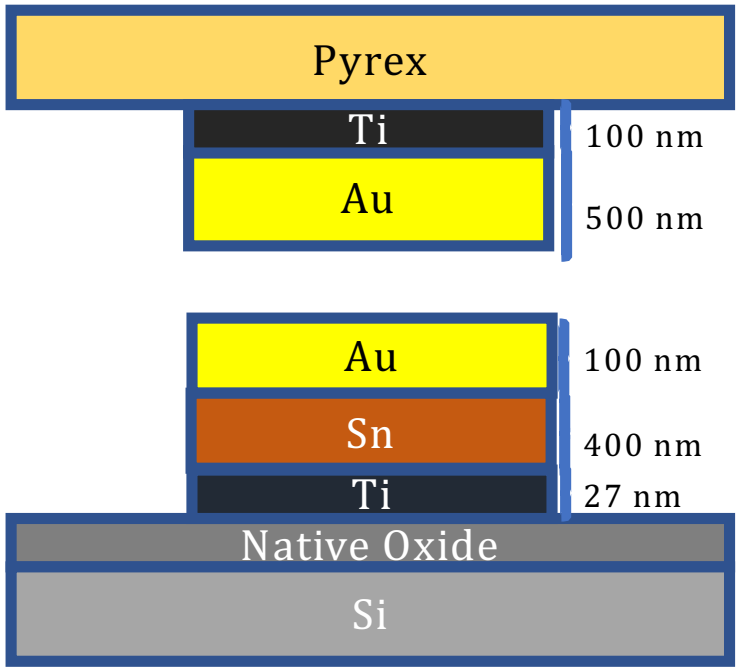
Bonding : Fine-tech Lambda Flip-Chip Bonder

Alignment Issue



15mm x 15mm

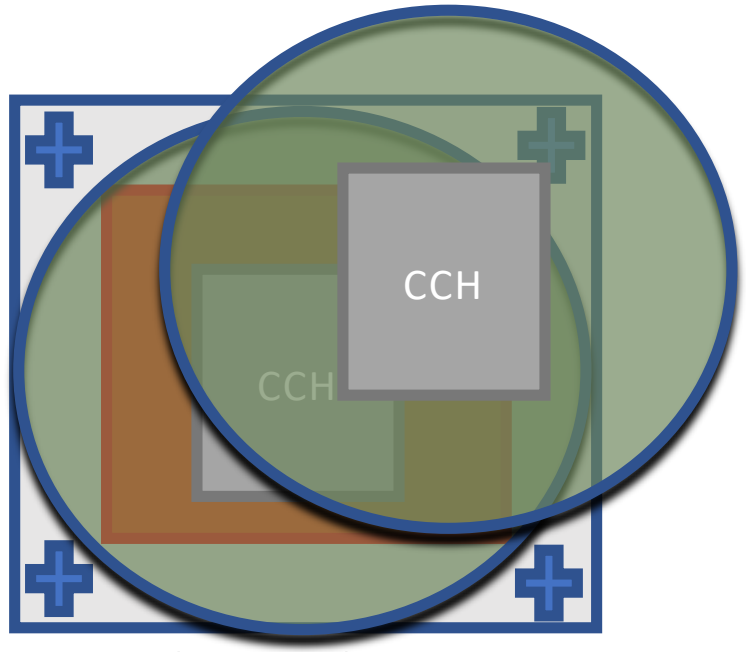
Substrates before Bonding



- The maximum field of view of the camera which is used to align the top and the bottom substrates is roughly a circle of 0.6 mm diameter at the lowest magnification. So use alignment marks and substrate sizes accordingly.

Bonding : Fine-tech Lambda Flip-Chip Bonder

- Picking up the substrate at the location of the alignment marks decenters the bonding area from the CCH module causing non-uniform heating and non-uniform pressure application on the bond area.

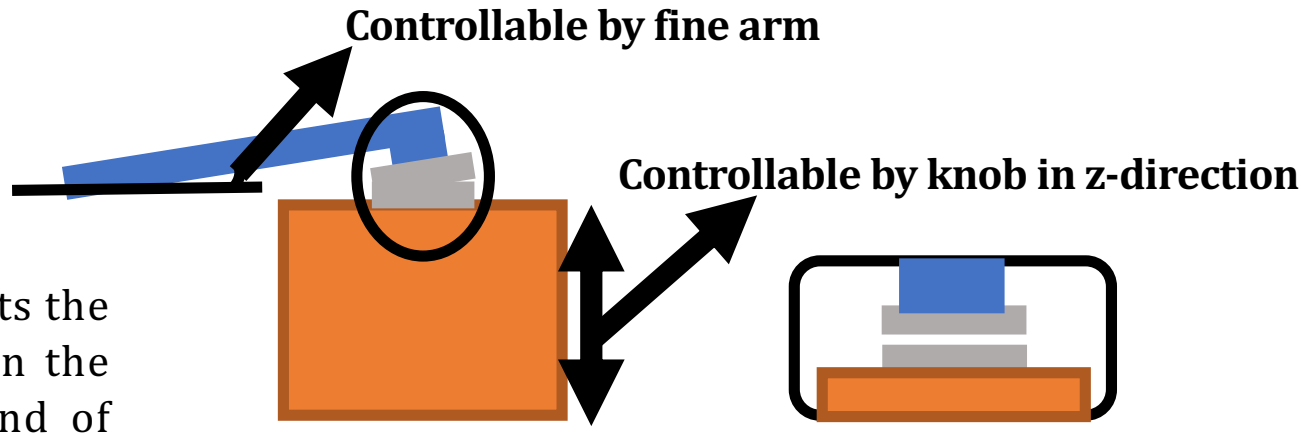


15mm x 15mm

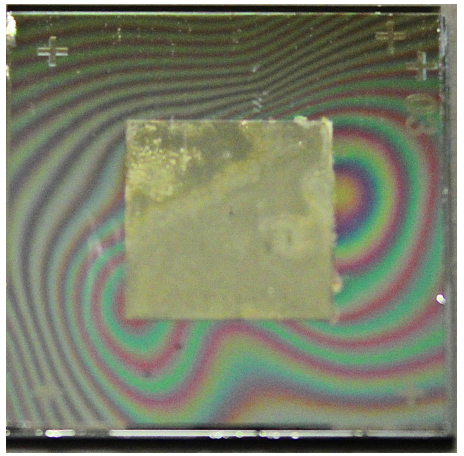
- Alignment was performed using the four sides of the bond area, since the camera can be translated and tilted to a small amount. Tilting the camera a lot is not desirable since it causes parallax errors and makes the top bond site appear slightly bigger than the bottom site.

Bonding : Fine-tech Lambda Flip-Chip Bonder

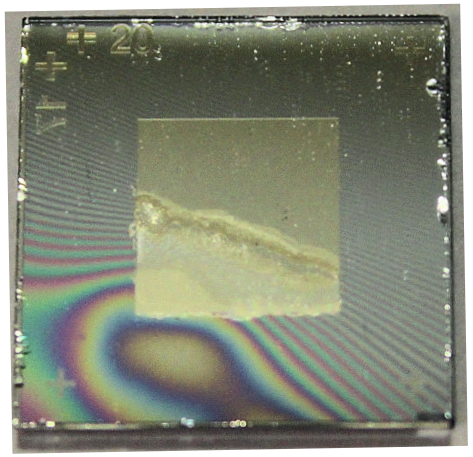
Non-Uniform Pressure Issue



The top arm of the bonder closes in radially and contacts the bottom plate. A side camera is used to view and align the two plates as parallel as possible. Absence of any kind of electronic or mechanical system that measures the flatness of the two substrates before the start of the bonding process is a huge drawback of the current bonder system. Because of human error in judging flatness of each set of samples, repeatability of an experiment is lost and we never obtain any two sets of reproducible pressure distribution in our samples.



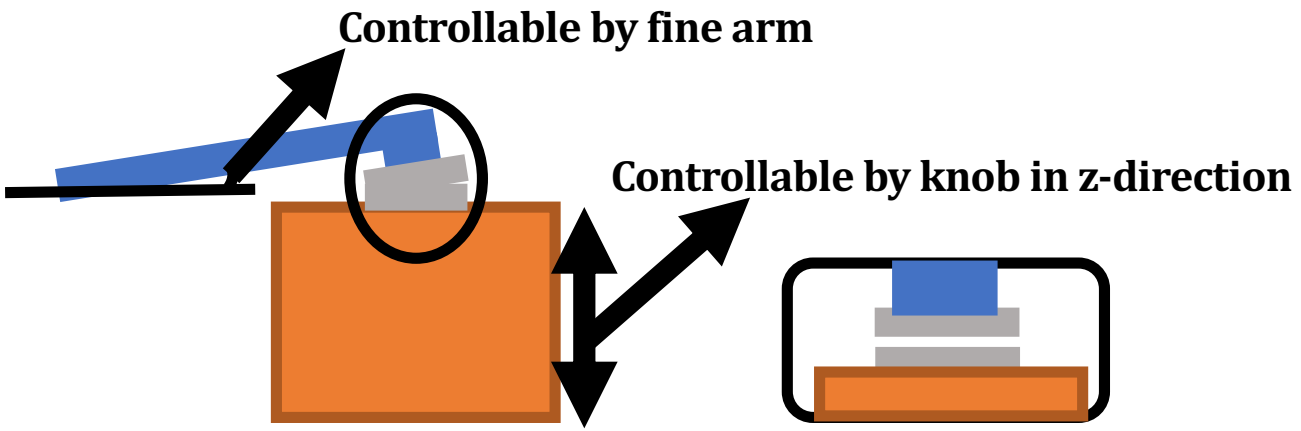
More or Less Uniform pressure



One Sided pressure application

Bonding : Fine-tech Lambda Flip-Chip Bonder

Possible Fix for pressure non-uniformity



Perform a small experiment by changing the z-positions and recording the location which gives best contact (to be judged by observing interference fringes). The optimal z-location will be very sensitive to the thickness of the substrates and the metal layers and so can not be generalised for all kinds of experiments. When the temperature is kept well above the Eutectic temperature, pressure uniformity has been established as the most critical parameter affecting bond quality, uniformity and strength, which makes it worthwhile to do this small experiment with top substrate as pyrex and determine the z-location which provides best contact between the substrates.

Testing of Pyrex Wafer : Dicing issues using DISCO Wafer saw

Remember to use HUB Blade for Silicon Wafers
and use RESIN Blade for Pyrex wafers

SNF Wiki

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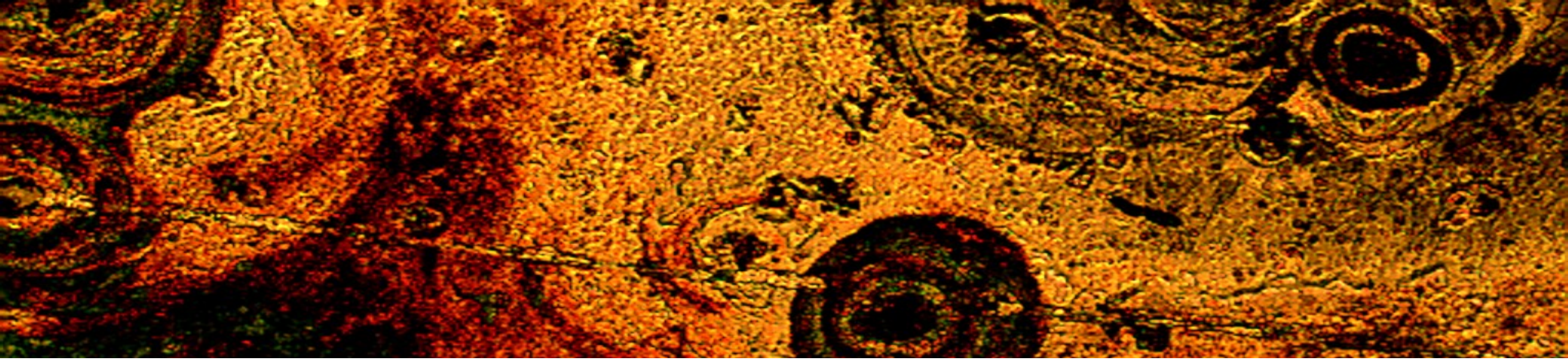
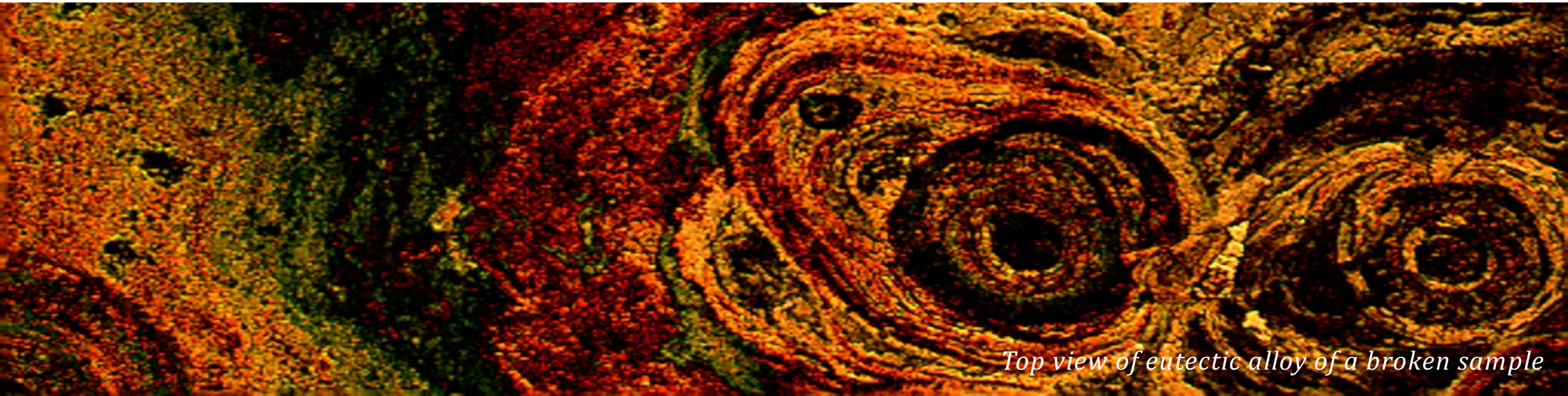


ALL THE BEST



Top view of eutectic alloy of a broken sample