Factors affecting wafer alignment during anodic bonding

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Abstract- There are several factors that affect the alignment accuracy for anodically bonded silicon : glass wafers. The main items are:

- Finite thermal expansion difference between glass and silicon
- Bow / warp in the silicon / glass wafers
- Movement of the wafers when brought into contact
- Accuracy of the optical alignment system
- Operator skill

In this paper we examine the various factors and determine their contribution to the overall final misalignment for typical bonded silicon : glass wafer pairs. The misalignment has been measured by using special wafer pairs[1] with alignment measurement verniers (see Figure 1) situated in various parts of the wafer, including a pair that is suitably located to enable continual viewing through the in-situ, dual camera, optical alignment system of the wafer bonder. Using this system we have been able to separately measure the initial misalignment when the wafers are in close proximity, the change when they are brought into contact, and further changes as they are heated from room temperature to the bonding temperature.

The results show that, unless allowed for during the mask layout, the finite thermal expansion difference between silicon and the typical pyrex glasses used for bonding (eg Schott Borofloat and Corning 7740), is the most significant factor with misalignment values of ~+/-6µm over a 150mm wafer.

Alignment accuracy read-out
(dimensions on-mask):

Si structures:	3 µm wide
Glass structures:	5 µm wide
Range:	from –6 to 6 µm
Accuracy:	± 0.25 µm

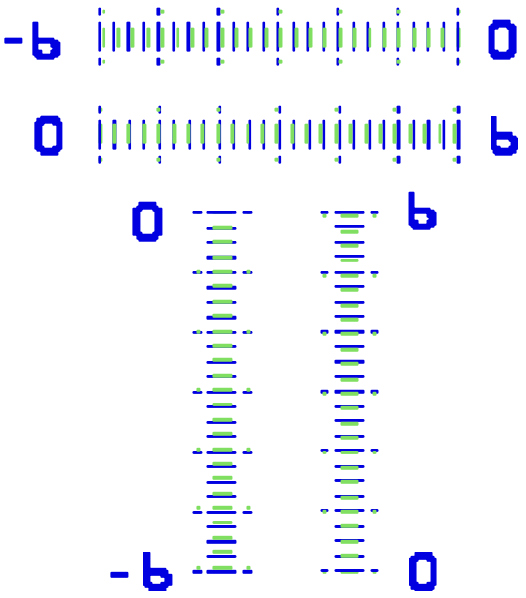

Figure 1 Alignment Accuracy Readout “Vernier” used to Pattern the Silicon & Glass

Conclusion: The result so far indicate that it is of no use having an alignment capability better than 5 microns in a bonding machine because accuracies better than this are limited by fundamental material properties.

[1] Wafers supplied by OnStream MST B.V, The Netherlands